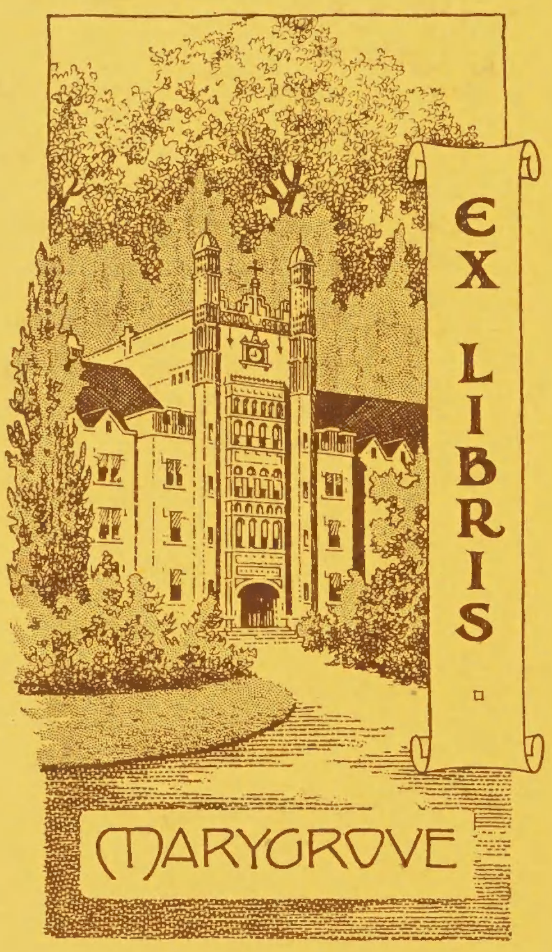
MANUAL ON METHODS
OF
REPRODUCING RESEARCH MATERIALS

ROBERT C. BINKLEY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MANUAL ON METHODS
OF
REPRODUCING RESEARCH MATERIALS

A Survey made for the Joint Committee on Materials for Research of the Social Science Research Council and the American Council of Learned Societies

By

ROBERT C. BINKLEY
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With the assistance of
Dr. T. R. Schellenberg, Professor Miles Hanley
Miss Josephine McCarter, Miss Adeline Barry
and Many Others

EDWARDS BROTHERS, INC.
ANN ARBOR, MICHIGAN
1936

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Ann Arbor, Michigan, 1936

FOREWORD

The Joint Committee on Materials for Research had its inception in action taken by the Social Science Research Council at its Hanover conference in August, 1929. At this conference the Council approved a tentative definition of its objective which included the "enlargement, improvement, and preservation of materials." This was elaborated as follows:

"Since scientific progress in all fields is conditioned by the existence of a constantly enlarging body of research materials and by its availability to investigators, one of the primary duties of the Council is to promote such objects and to concern itself with the improvement and preservation of research data. In carrying out these purposes the following courses of action are appropriate:

A. Initiating and participating in plans for making more comparable and more widely serviceable the classifications of social and economic data, for making more precise the significance of the data, and for otherwise improving such records.
B. Helping to lay out a plan for the nation-wide development and coördination of existing archival collections and for the building up of new research collections along special lines at strategic scholarly and geographical centers.
C. Initiating and participating in plans for constructing union finding lists and calendars of the resources of existing research libraries, with particular reference to their social data, so as to make them more available to scholars.
D. Initiating and participating in plans to discover, select, edit, publish, or otherwise reproduce basic data in the social sciences, which are difficult of access to students or likely to perish.
E. Calling to the attention of individuals and of governmental, business, and other institutions and agencies the importance of preserving their records for future analysis and study.
F. Encouraging the adoption and widespread use of those varieties of paper and other materials used in the making of records which promise a maximum durability.
G. Initiating, encouraging, and participating in plans to develop the research uses of historical, industrial, and social museums; and encouraging the building up of new collections with these purposes in mind."

The American Council of Learned Societies, which is interested primarily in the humanities, including history, had concerned itself for some years with materials for research; and, as the problems of the two Councils in this field are much the same and often involve the same material, it was logical for them to join in setting up a joint committee on materials for research. This committee, after a number of changes in personnel, consists at present of the following members:

Robert C. Binkley, Western Reserve University, Chairman
T. R. Schellenberg, National Archives, Secretary
Laurence V. Coleman, American Association of Museums
Norman S. B. Gras, Harvard University
H. M. Lydenberg, New York Public Library
Arthur H. Quinn, University of Pennsylvania
Verne E. Chatelain, National Park Service

In the course of its first two meetings in 1930, the committee set on foot three surveys. A "Survey of Activities of American Agencies in Relation to Materials for Research in the Social Sciences and Humanities" was compiled by Franklin F. Holbrook, under the direction of Professor Solon J. Buck, and published in a small edition in the spring of 1932. A study of the categories of research material which ought to be collected and preserved was undertaken by a subcommittee headed by Professor Gras. The task of making a survey of methods of reproducing research materials was assigned to Robert C. Binkley, then secretary of the committee. A tentative edition of this survey was issued in December, 1931, and circulated for corrections and additions, which have been incorporated in the present edition.

ACKNOWLEDGMENT

The collaboration of scholars, technicians, and business men in the preparation of this manual has been generous and long-continued. The list of names carried in the index is in itself a list of helpful collaborators to whom acknowledgment is due. If the list were to be extended to all who have given sympathetic aid, it would cover pages.

The correspondence covering the matters brought together in this book has been carried on for six years. The conclusions here set forth have been slowly crystallized in the presence of constantly changing cost levels and constantly improved mechanical equipment. Much of the book that deals with tabulations of cost and with descriptions of equipment will undoubtedly be outdated in the near future; some of it is perhaps already out of date at the moment of going to press.

It is hoped, however, that the basic thought of the book will still stand: namely, that the great variety of devices which modern technology offers to modern scholarship should be kept under constant scrutiny, both from the standpoint of utility and of comparative cost.

Western Reserve University
April 14, 1936

Robert C. Binkley

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TABLE OF CONTENTS

Chapter Page

I. THE SETTING OF THE PROBLEM OF REPRODUCING RESEARCH MATERIALS 1

II. PUBLISHING AND LIBRARY COSTS: THE BOOK 3
- Analysis of Production Costs 3
- Volume of Scholarly Publishing 7
- Scholarly Market 8
- Library Costs 9

III. PRINTED BOOKS AND REPRINTS 13
- Printing with Raised Type on Cylinder Presses 14
- Printing: Composition Costs 15
- Printing: Area Costs 16
- Printing: Running Costs 17
- Printing: Analysis of Costs 17
- Multigraph Process 18
- Alternatives to Printing 21
- Reprinting: Photo-Offset Process 21
- Photo-Offset: Composition Costs 22
- Photo-Offset: Area Costs 22
  - (a) Photographic Negative 22
  - (b) Preparation of Metal Plate 23
  - (c) Full Utilization of Metal Plate Surface 23
  - (d) Area Costs and Legibility 24
- Photo-Offset: Reprint Economy 25
- Photo-Offset: Outlook for the Future 26
- Reprint Processes: Dermaprint 27

IV. THE TYPESCRIPT BOOK OR MEMORANDUM: THE TYPEWRITER AND TYPESCRIPT 31
- The Standard Typewriter 31
- Equivalence of Type and Typescript 32
- Uneven Right-Hand Margin 33
- Varityper and Electromatic Typewriters 33
- Typing Stages in Book Production: Draft, Fair, and Format Copies 34
- Fair Copy as a Stage in the Writing Process 35
- Fair Copy as a Stage in the Multiplication of a Book: Merging of the Fair and Format Copies 36
- Preparation of Format Copy from the Fair Copy 37
- Area Costs and Format 38
  - (a) Size of Type 38
  - (b) Interlinear Spacing 38
  - (c) Length of Line 40

V. THE TYPESCRIPT BOOK OR MEMORANDUM: REPRODUCTION TECHNIQUES 41
- Carbon Paper Copying 41
- Hectograph Process 41
  - (a) Gelatin Hectograph Process 43
  - (b) Liquid Hectograph Process 43

Chapter Page

Cost Analysis of Hectographing 44
(a) Composition and Running Costs 44
(b) Area Costs and Legibility 44
(c) Application of Hectographing to Problems of Scholarship 46
Mimeograph Techniques: Mimeographing and Direct Typing Offset Printing .. 46
Composition Cost Analysis 47
Area Costs and Format 47
Explanation of Sample Pages and Cost Table 49
Photo-Offset from Typescript 53
Justification for Increased Area Costs 53
Photographic Reduction of Typescript:
(a) Economies in Type Size 53
(b) Length of Line and Economy 54
Specifications for Reproducing the Same Book at the Same Cost by Mimeographing and by Photo-Offset 54
Photo-Offset Typescript Book Format: Full Utilization of Printing Surface 55
Photo-Offset from Normal Fair Copy without Additional Format Typing 59
Typing Instructions 62
The Manuscript Book 62
Cost Analysis: Composition Costs 63

VI. BLUEPRINTING, PHOTOSTATING, AND ALLIED TECHNIQUES 65
Van Dyke and Lithoprint (First Costs High; Running Costs Low) 65
Blueprinting and Photostating (First Costs Low; Running Costs High) 66
Maximum Use of Area 68
Prices per Square Foot 68
Copying of Documents without a Camera 68
(a) Direct Contact Copying 68
(b) Reflection Copying 71
Photostat 71
Photocopying Equipment 73
Dexigraph 76
Technological Frontier 76
Comparative Costs in Book Production 77

VII. BOOKS CONTAINING CHARACTERS NOT IN THE ROMAN ALPHABET, TABULAR MATTER, DIAGRAMS AND ILLUSTRATIONS 81
Classification of Special Problems 81
Reproduction in Typescript, Manuscript, and Relief Printing without Pictorial Matter 82
Techniques in the Reproduction of Pictorial Matter 83
Photoengraving and Photo-Offset 85
Half-tone Pictures in Photo-Offset and Photoengraving 85
Large and Small Offset Presses in Pictorial Work 86
Photogelatin or Collotype 87
Intaglio Processes: Photogravure 88
Aquatone and Pantone 89
Dermaprint 90
Photosensitive Paper Processes 90
Cost Comparisons 90
Combinations of Pictorial and Textual Matter 90
Summary 93

Chapter Page

VIII. A STUDY OF PAPER PERMANENCE 95
Proposed Classification and Specifications for Permanent Book Papers 98
Paper Trade and the Proposed Specifications 101
Conclusions for the Paper Buyer 101
Influence of Price 104
Preservation of Old Newsprint Paper 105
Appendix 106

IX. BINDING, VERTICAL FILING, AND FILM STORAGE 111
Vertical Filing 111
Binding 111
  (a) Vertical File Material 111
  (b) Pamphlets and Periodical Material 112
  (c) Bookbinding Techniques 113
  (d) Bookbinding Costs 113
Film Storage 113

X. REDUCED-SCALE PHOTOGRAPHIC AND PHOTOLITHOGRAPHING COPYING ON PAPER FOR READING THROUGH MAGNIFYING GLASSES 115
Thresholds of Legibility 115
Reduced-Size Newspapers 115
Peters' Miniature Abstracts and Theses 116
Fiske Method 117
Filmstat Reproduction 117
Bendikson Procedure 118
Van Iterson Device 118
Folmer Graflex Recording Camera 119
Tru-Vue Apparatus 119

XI. COST LEVELS AND APPLICATIONS OF MICROCOPYING AND PROJECTION READING 121
Resolving Power of Emulsion 121
Reduction Ratio in Copying 121
Process-Positive Emulsion 122
Camera and Lens System 122
Limits of Reduction Ratio 122
Cost of Photosensitive Surface 125
Film or Glass Versus Paper 126
Film, Glass, or Paper: Film Strips or Rectangles? 126
Full Use of Area of Moving Picture Film 128
Processing Costs 129
First Costs and Running Costs in Microcopying 131
Microcopying "Reprint Costs" 133
Short Footages in Unique Copies 134
Microcopying and Long-Distance Use of Libraries: the Bibliofilm Service 134
Microcopying and Copyright 135
"Publishing" Short Runs of Material by Microcopying 139
Problem of Standardization of Equipment and Reduction Ratio 140
Essentials of Design for Reading Equipment 143
  (a) Length of Line 143
  (b) Page Rectangle 144
  (c) Aperture 146
  (d) Enlargement Ratio 147
Film Storage and Durability 152
Microcopying of Newspapers 155
Microcopying and Library Cataloguing 157

Chapter Page

Photography as the Scholar's Amanuensis 159
Merging of Collecting and Publishing 159

XII. PHOTOGRAPHIC AND PROJECTING APPARATUS 161
The Camera and the Use of Film 161
The Camera and the Mechanics of Operation 162
Cinescopie and Photoscopie 162
E.K.A. Camera and Lemare Ampligraph 164
Leica and Contax Equipment 164
  (a) Lens and Camera 165
The Argus 168
Ansco Universal Still-Film Copying Camera 168
Ludwig Camera 169
Matson Camera 169
Filmograph and Kennedy Cameras 169
Draeger Camera 170
Folmer Graflex Camera 170
Recordak Bound-Book Copying Cameras 171
Recordak Camera 172
Newspaper Recordak 172
Projector Reading Machines 172
Projector-and-Enlargement Equipment 175

XIII. THE RECORDING OF SOUND 177
Cost Levels of Sound Reproduction 177
Technique of Phonographic Recording 177
Sound Recording Methods 178

XIV. CONCLUSION 183
Size of Edition. The Efficiency Point 183
Comparative Costs per 100,000 Words at Efficiency Point 186
Allocation of Costs of Reproducing Materials 189
Publication Service of Microcopying 191
Services of the H. W. Wilson Company 194
Plans for the Photo-Offset Reproduction of Rare Items 194
Concentration of Scholarly Book Production 194
Concentration of Processing Services for Microcopying 195
Allocation of Costs, and the Problem of Appraisal and Listing 195
Intellectual Implications of Technological Change 196
The First Stage: Collecting and Preserving Materials 197
The Second Stage: Improvement of Different Types of Material 198
  (a) Books, Periodicals, and Printed Public Documents 198
  (b) Newspapers 199
  (c) Public Archives 199
  (d) Business Records 200
  (e) Ephemeral Materials and Non-Trade Documentation 200
  (f) Family Papers 200
Simplified Research Techniques 201

INDEX 203

LIST OF TABLES

Table Page

I. Costs in Commercial and Scholarly Publishing 4
II. Costs and Returns from a Typical Research Book 7
III. Acquisition Sums Spent by Forty of the Larger University and College Libraries 8
IV. Estimates for Printing by Mimeoform and Straight Printing a Book of 50,000 Words 20
V. Estimates for Printing by Mimeoform and Straight Printing a Book of 50,000 Words in Economy Format 20
VI. Prices on Photo-Offset Printing Surface 23
VII. Cost of Printing Surface for Dermaprint, Rotaprint, and Multilith Work .. 28
VIII. Prices of Dermaprint Service 29
IX. Comparison of Factors Affecting Book Manufacturing Costs 30
X. Types of Varityper Machines 34
XI. High Variation in Typescript Composition Costs per 1,000 Words 39
XII. Number of Carbon Copies Possible with One Typing 41
XIII. Variation of Normal Cost of Labor and Materials in Composition Costs in Carbon Copying 42
XIV. Cost of Carbon Copy Books of 100,000 Words 42
XV. Cost of Liquid Process Hectograph Books of 100,000 Words 45
XVI. Prices of Mimeograph Stencils 47
XVII. Prices of Metal Sheets for Direct Typing 48
XVIII. Costs of Printing Surfaces for Direct Typing 48
XIX. Formats for Accommodating Various Number of Words per Page 50
XX. Mimeograph Costs for Producing 100,000 Words in Variety of Formats 51
XXI. Comparison of Office and Shop Charges for Mimeographing Book of 100,000 Words 52
XXII. Cost of Reproducing 100,000 Words by "Mimeograph" Processes..... 52
XXIII. Composition Costs of Format Copy of Book under Varying Conditions of Cost Distribution 57
XXIV. Photo-Offset Prices 61
XXV. Chart of Blueprint Dimensions 69
XXVI. Price per Square Foot of Blueprint and Allied Processes 70
XXVII. Costs of Photostat Paper to Produce 100-Page Book in Different Page Sizes 72
XXVIII. Chart of Photostat Prices 74
XXIX. Comparative Costs of Typescript, Photostat, Blueprint, and Photo-Offset . 78
XXX. Key Figures of Unit Costs of Reproduction 79
XXXI. Cost of 100-Page Octavo Book Containing All Pictorial Matter 91
XXXII. Costs of Reproducing Book of Pictorial Matter in Varying Page and Picture Sizes 92
XXXIII. Analysis of Production Costs of Illustrations Combined with Text 94
XXXIV. Classification of Book Papers 99
XXXV. Book Papers and Proposed Permanence of Classifications 102
XXXVa. Chart of Paper Specifications 110
XXXVI. Cost of a Good Library Binding for a Book 1 1/2" Thick 114
XXXVII. Thresholds of Legibility in Reductions of Typescript and Newsprint 116
XXXVIII. Reduction Ratio and Legibility of Projected Image of 7-Point Newsprint Photographed in Different Kinds of Microcopying Cameras 123
XXXIX. Price per Square Foot of Usable Surface 126

Table Page

XL. Comparative Prices of Photographic Surface on Paper, Glass, and Film; with Reduction Ratios to Bring Prices to Common Levels 127
XLI. Film Footages Required in Copying Books in Different Positions on 35mm. Film and 16mm. Film, Using Full Width of Film 129
XLII. Prices of Film Processing 129
XLIII. Effect of Variation in Processing Costs on Price of Microcopy Positive of a Book of 100 Pages, 6" x 9", in Varying Reduction Ratios 130
XLIV. Graph Showing Amount of Microcopying Necessary to Justify Expenditure of Any Given Increment in Price of Reading Machine Equipment 142
XLV. Chart of Apertures and Correspondence to Frame of Film 148
XLVI. Costs of Acquiring or Maintaining One Year of a Newspaper File of Approximately 18,000 Pages per Year 156
XLVII. Chart Showing Chief Characteristics of Copying Cameras 163
XLVIII. Chart Giving Chief Characteristics of Projectors 176
XLIX. Running Costs Stated as Percentages of First Cost 184
L. Efficiency Point in Edition for Various Processes 185
LI. Edition Size at Which 90% of Unit Cost is Running Cost and 10% is First Cost 185
LII. Efficiency Costs for Three Processes 186
LIII. Costs per Thousand Words at Efficiency Point 187
LIV. Edition Size at Which Cost of Production is Approximately $1.50 per 100,000 Words 188
LV. Unit Costs for Reproducing 100,000 Words in a Variety of Processes in Editions of 1 to 100 190

LIST OF ILLUSTRATIONS

Figure Facing Page

I. Example of Century Expanded and of Granjon Type 15
II. An Economical Print-Face Format 15
III. An Economical Print-Face Format 15
IV. Example of 8- and 10-Point Bodoni Type 17
V. Model 100 Multigraph 18
VI. Page of Mimeoform Work 19
VII. An Economical Mimeoform Format 19
VIII. Sample Piece of Multilith Metal Sheet 21
IX. Sample Piece of Rotaprint Metal Sheet 21
X. The Rotaprint 21
XI. Model 200 Multilith 21
XII. Harris Press 22
XIII. Curve of Diminishing Legibility 25
XIV. Page of Dermaprint Work 27
XV. Comparison of Print and Reduced Typescript of Same Legibility 32
XVI. Page Demonstrating Spielvogel Aligning Paper 33
XVII. Sample of Varityper Work Reduced by Photo-Offset 33
XVIII. Sample of Varityper Work Done on Mimeograph 34
XIX. Page of Photo-Offset Work Done on Different Machines 37
XX. The Ormig Duplicator 43
XXI. The Standard New Process Duplicator 43
XXII. Sample of Hectograph Gelatin Work 45
XXIII. Samples of Hectograph Liquid Work (Standard New Process) 45
a and b
XXIV. Sample of Hectograph Liquid Work (Ormig) 45
XXV. Sample of Rotaprint Direct Typing Work 49
XXVI. Sample of Multilith Direct Typing Work 49
XXVII. Sample of Mimeograph Work on Wax Stencil 49
XXVIII. Sample of Micro-Elite Mimeograph Work 49
XXIX. Comparison of Print and Reduced Typescript with Same Word Content ... 53
XXX. An Economical Photo-Offset Format 53
XXXI. An Inexpensive Photo-Offset Format 58
XXXII. An Inexpensive Photo-Offset Format 58
XXXIII. An Expensive Photo-Offset Format 59
XXXIV. A Typical Photo-Offset Format 59
XXXV. A Typical Photo-Offset Format 59
XXXVI. A Manuscript Page Reproduced by Photo-Offset 63
XXXVIIa. Example of B-W Work 67
b. Example of Blue Line Print from Paper Negative 67
XXXVIII. The Photostat 73
XXXIX. The Rectigraph 73
XL. The Dexigraph 76
XLI. Screened Picture Run on Harris Press 86
XLII. Screened Picture Run on Rotaprint Press 87
XLIII. Screened Picture Run on Multilith Press 87
XLIV. Sample of Collotype Work 88
XLV. Sample of Collotype Work 88

Figure Facing Page

XLVI. Sample of 80-Line Zinc Cut 88
XLVII. Sample of 133-Line Copper Cut 88
XLVIII. Sample of 80-Line Zinc Cut 88
XLIX. Sample of 133-Line Copper Cut 88
L. Page of Aquatone Work 89
LI. Example of Photo-Offset Half-tone Work 91
LII. Example of Photo-Offset Half-tone Work 91
LIII. Sample of Newspaper Preservation 105
LIV. Quarter-Size Page of New York *Times* 115
LV. Photo-Offset Reproduction of Abstract Page Done by Peters' Method 116
LVI. The Fiskoscope 117
LVII. Fiske Reading Strip 117
LVIII. Spencer Magnifier 118
LIX. Bendikson's Microprints 118
LX. Bendikson's Microscope 118
LXI. Van Iterson's Device 119
LXII. Examples of Photo-Offset and Typescript Reduced and Enlarged 124
(a,b,c)
LXIIIa. Collotype Reproduction of Dagron Film 124
LXIV. Sample of 16mm. Film 126
LXV. Sample of 35mm. Film 126
LXVI. Leica Camera, Projector, and Accessory Lenses 165
LXVII. Draeger Camera (Early Model) 170
LXVIII. New Folmer Graflex Camera 170
LXIX. Recordak Copying Camera 172
LXX. Recordak Projector 172
LXXI. Teledex Projector 174
LXXII. Spencer Projector 174
LXXIII. Professor Hanley's Phonographic Equipment 180

CHAPTER I

THE SETTING OF THE PROBLEM OF REPRODUCING RESEARCH MATERIALS

Research in the social sciences and humanities is unlike research in the natural sciences in that it uses written texts as its principal material. The first duty of scholarship is to protect and preserve original writings, the loss of which would be irretrievable. Except in the case of records committed to perishable paper, this service does not call for the reproduction of the texts. But great importance must also be attached to those mechanical impediments which hinder a scholar whenever he is compelled to alter his plans or suspend his work because he can neither go to the material he needs nor have the material brought to him. Unless a given body of research material is reproduced in so many copies and distributed in so many places that it is accessible to all the scholars who wish to use it, the mechanical impediment to the use of that body of material has not been wholly removed.

In the days when the classics and the works of the Fathers constituted the principal body of research material, a scholar was not unlikely to have the core of his research material in his own private library. As the scope of the disciplines expanded and the stock of printed matter accumulated, increasing dependence was placed on the college or university libraries. A generation of great librarians solved the problems of cataloguing and administering these libraries. Now, as the tonnage of needed material continues to increase, the ordinary college library becomes as inadequate as the private library, and the prospect appears that nothing less than the whole system of research libraries, coöperating with each other and allocating responsibilities among themselves, will be able to supply the research scholar's needs. The Association of Research Libraries was formed in April, 1932, to grapple with this problem, and the American Library Association Committee on Bibliography has long been working upon it.[1]

In dealing with the problem of research materials, three interests are to be distinguished: those of the scholar as a producer, of the scholar as a consumer, and of the library as a custodian. The scholar as a producer wants to see his manuscript set up in type, printed on good paper, bound in buckram, and distributed in as large an edition as possible. Although "book form" is an arbitrary and mechanical criterion of scholarly value, it is given weight in academic circles. The consumer interest is that of the man who is using a library. All the documents of which he makes use are for him "materials for research." He does not care whether they are printed or typewritten or in manuscript form, whether durable or perishable, whether original or photostat, so long as they are legible. Whether the edition is large or small, whether the library buys, begs, or borrows the material makes no difference to him so long as he can have it in hand when he wants it. The custodian's interest has to do with the demands of future generations of scholars. The growth of each library must be so directed that its present acquisitions dovetail with past and future acquisitions. The custodian must also undertake to gather items for which there is no present demand on the part of the "consumer"; he may seek especially to care for the unique things which are nowhere else collected and preserved. That these interests may be difficult to reconcile with each other is illustrated both in the production and in the distribution of material.

In the production of books the line of technical development has been in the direction of lower costs for larger editions. Rotary presses and wood-pulp paper, as well as the sales and promotion policies

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1. See "A Restatement of the A.L.A. Plan for the Promotion of Research Library Service by Coöperative Methods," made for the A.L.A. at the request of the Secretary, by the Chairman, November 3, 1930. Washington, D. C., 1930.

of publishers, emphasize the importance of securing a wide market. But scholarship, with its tendency to increased specialization, has been constantly diminishing the number of probable users of any given scholarly publication. Publishers' requirements are met with impermanent papers, while the custodians' interests call for maximum permanence.

In the distribution of books, that is to say, in the formulating of library acquisition policies, the consumer and custodian interests clash. The graduate schools are feeding into the university and college system a highly trained personnel, expected to pursue research work along with teaching. To secure the maximum of research effort from this teaching personnel, the libraries should be so equipped that any scholar can pick up his work and go on with it wherever he may happen to be teaching. In the attempt to meet the need, library funds are turned this way and that, regardless of long-term policies, to supply the research requirements of the man who happens to be on the ground. But this interferes with the distribution of field among libraries, which is necessary if the total resources of scholarship are to be used most efficiently in collecting and preserving materials.

An inquiry into the techniques of reproducing research materials is called for at the present time because there are coming to light new processes and devices which, taken in their entirety, promise to have an impact on the intellectual world comparable with that of the invention of printing. The typewriter and the photostat were the precursors of the array of new devices, among which the planograph, or photo-offset, and the miniature film copy have the most interesting possible applications. The photo-offset process now controls the bringing back into print of old books, pamphlets, and journals. A few more inventions along the present line of technological development may result in rendering "reprinting" a kind of simple addition to the functions of a library, as photostating has come to be. The use of miniature film copies is in its very infancy, but progress along its line of development would tend to bring the cost of making a unique copy of a book lower than the normal original purchase price, lower perhaps than the cost of mailing and returning an interlibrary loan--a situation with revolutionary implications. Book and journal publishing, now taken for granted as the sole channels for the flow of an intellectual product, may be challenged by the consequences of these technological changes. Perhaps the time may come when the internal documents of scholarship will circulate like the internal documents of a great business enterprise, with the journal and the book appearing in their present volume as vehicles of communication, but supplemented by innumerable memoranda drawn up and multiplied by inexpensive office duplicating processes. Such possibilities lie in the realm of dream and prophecy. For the present there is required only an attentive watching of the new processes and an effort to compare them, fitting each one into its most appropriate place.

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CHAPTER II

PUBLISHING AND LIBRARY COSTS: THE BOOK

The point of reference from which the problem of reproducing research materials must be examined is the system by which publishers produce books and libraries acquire, arrange, and store them for use. The financial policies of institutions, the stack room and reading room equipment of libraries, the training of library personnel, as well as the research habits of scholars, are standardized in favor of the use of books of several hundred pages, from 6" to 11" in height, costing the purchaser from $.005 to $.02 a page.

There are other forms in which research material is made accessible, but in any of these other forms there is created a special problem of finance or administration. Maps, newspapers, "oversize" books, manuscript collections, films, collections of pamphlets and broadsides present special difficulties and cause special expenses regardless of their acquisition costs.

Scholarly books published in America are sold at an average price of $1.20 per 100 pages, scholarly periodicals at $.70 per 100 pages.[1] A library dollar buys 73 pages, approximately 32,000 words, in book form; or 150 pages, 67,000 words, in journal form. If research materials in book form can be sold unbound at the price level of periodicals or with good library binding at the normal book price, they can be fed into the library system of the country without requiring significant changes in present acquisition policies.

Analysis of Production Costs[2]

The cost accountancy of book production is very complicated, but the basic fact is simple: the unit cost of producing a book falls rapidly as the size of the edition increases. This is the essential accountancy difference between the printed and the photographic (photostat or film-slide) copy of a text. The unit costs in the one case diminish rapidly as the size of the edition increases; in the other case they are more nearly constant for any number of copies. When the prospective market, and hence the size of the salable edition, is so small that the unit cost of the volume rises above the level at which the normal purchasing policies of institutions or individuals will float the enterprise and accomplish adequate distribution, the point is reached where commercial and scholarly needs conflict with each other. The critical test of book costs, for the purposes of this survey, is the minimum size of an

---

[1] Average Retail Price of Books, per 100 Pages.

	General Books	Scholarly Books
United States	$.53	$1.20
Great Britain	.86	1.20
Germany	.75	1.04
France	.58	.34 (unbound)
Italy		.65

[2] A number of reports and handbooks have collected material on this subject. Most important are Donald P. Bean, Report on American Scholarly Publishing (Chicago, 1931), a mimeographed document of about 200 pages; O. H. Cheney, Economic Survey of the Book Industry, 1930-31 (New York, 1931), the final report of Cheney to the National Association of Book Publishers which analyzes the commercial publishing industry; Fred Hoch, Standard Book of Estimating for Printers (Chicago, 1929), issued by the United Typothetae of America, which analyzes printing costs; John Marshall, Publication of Books and Monographs by Learned Societies (1931), a survey made for the American Council of Learned Societies, Bulletin No. 16.

edition which can be sold within the normal price range.

Another striking characteristic of book costs is the high percentage of the sale price which goes to pay for other things than manufacturing costs. One university press reports that 33% to 50% of all money received goes to pay for distribution. Another reports that it calculates that only 40% of the cost of a book is the actual production cost. Two very complete estimates and analyses of book costs are available in the surveys made by Mr. O. H. Cheney and Mr. Donald Bean.[3] Mr. Cheney reports on commercial publishing, Mr. Bean on scholarly publishing. Both writers calculate the disposition of the money actually received by the publisher. In the case of commercial publishing this is much less than the amount paid for the books by the consumer, because the retail dealer's profit of 40% must be included. The commercial publisher's dollar is the consumer's $.60.

The dealer's discount in scholarly publishing is reckoned at 30% by Mr. Bean, and the calculation is further made that the scholarly publisher is subsidized by authors and institutions to the extent of 35% of his costs. Therefore the publisher's dollar in scholarly publishing is the consumer's $1.07. For every dollar paid by the consumer for a commercial book, the publisher gets $.60; for every dollar paid retail for a scholarly book, the publisher gets $1.07.

These relationships between cost and price must receive further analysis, but in the meantime note must be made of the distribution which publishers make of each dollar[4] they receive. (See Table I.)

Part of the larger percentage of manufacturing costs found in Mr. Bean's figures may be due to the inclusion of some items which Mr. Cheney classes as overhead. Moreover, Mr. Bean's whole system of accounting seems to disregard separate books after the first year of sales and to total revenues from later sales to pay overhead costs. If an 18% overhead, presumably from sales of old books, is figured into Mr. Bean's costs of scholarly publishing, the result is:

Manufacturing	$.54
Editorial costs	.02
Royalties	.05
Selling and advertising ..	.19
Shipping and mailing	.02
Overhead	.18
	$1.00

The larger manufacturing cost ratio in scholarly publishing is the result of the smaller edition.

If every edition were invariably sold out, the retail price of a book could be fixed by dividing the cost of the whole edition into the number of copies and adding a profit. Actually, because of the risk element, the selling price must be much

TABLE I

COSTS IN COMMERCIAL AND SCHOLARLY PUBLISHING

	Commercial	Scholarly
Manufacturing	$ .36	$ .66
Editorial costs	.02	.03
Royalties	.17	.06
Selling and advertising	.19	.23
Shipping and mailing	.02	.02
Overhead	.18	
Bad debts, losses, profits ..	.06	
	$1.00	$1.00

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3. Cf. footnote on page 3.

4. These figures are adopted from those given in Cheney, p. 159, and in Bean, p. 90.

higher. It is usually fixed at three or four times the manufacturing cost. Dr. Arthur Meiner in the German Boersenblatt proposes a formula[5] for determining selling price, which is illustrated with typical figures by Mr. Bean:

> The largest element of print cost--the composition or typesetting--is a cost per page which is independent of the number of copies printed. The composition of a 400-page book, for example, at $2.25 per page is $900.00. If the number of books printed from this type is 1000, the cost of composition is $.90 per copy; if 10,000 are printed, the cost is $.09 per copy. While other elements of printing cost do not decrease so markedly as the quantity increases, the same principle applies to a limited extent. Thus the remaining costs of paper, presswork, and binding may be $400.00 for 1000 copies or $.40 per copy, and $.31 per copy or $3100 in quantities of 10,000 copies. The total manufacturing cost per copy of this imaginary book is, therefore, $1.30 in lots of 1000 copies, and $.40 per copy in quantities of 10,000 copies. Stereotype or electrotype plates costing approximately $1.25 per page additional have not been included, although a necessary cost if provision is to be made for additional impressions.[6]

The writer has learned that one great university press uses the following method of pricing, which bears some resemblance to the Meiner formula:

	Minimum	Average
1. Take the "shop cost" of the book (Mr. Bean sets this at $1300 for a minimum, $2200 for an average, for a book of 400 pages, 1000 copies.)	$1300	$2200
2. Add 20% for editorial overhead costs.	260	440
	$1560	$2640
3. Subtract from the edition 100 copies for review and promotion, and divide the total by the salable edition (900 copies) to get unit cost.	1.73	2.93

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[5] The formula suggested by Dr. Meiner for pricing this hypothetical book runs as follows:

$$\text{Selling price} = \frac{\text{Manufacturing Cost}}{1 - (\text{Author's royalty + overhead + profit + retailer's discount})}$$

The percentages which fill in this formula in ordinary commercial publishing are estimated by Bean as follows:

Author's royalty	10%
Overhead	30%
Profit	5%
Discount	30%
	75%

Consequently, the book described above, with manufacturing cost of $1.30 in lots of 1000, $.40 in lots of 10,000, would be priced:

$$\text{Selling price} = \frac{\$1.30}{1 - (\$.10;.30;.05;.30)} = \frac{\$1.30}{.25} = \$5.20\ (\$.013 \text{ per page})$$

But if the manufacturing cost is $.40, it would be $\frac{\$.40}{.25}$ = $1.60 ($.004 per page).

[6] Cf. Bean, p. 72.

	Minimum	Average
4. The sales price should then be fixed at three times this unit cost of the book if the book is to return cost of publication and a small royalty to author.	5.19 ($.013 per page)	8.79 ($.022 per page)
5. If this price, considering the final appearance of the book, and the average price of scholarly publications ($.022 per page), is so high as to discourage sales, it must be cut down.		

These figures indicate that even when an edition of 1000 is sold, the income from sales at the normal price of $.022 per page will not pay the cost of the edition. But the usual sale of a scholarly book is less than 1000 copies.

Mr. Marshall and Mr. Bean made independent studies of the normal size of an edition of a book written by a scholar for scholars. Mr. Bean thinks that the average first-year sale of a research book is between 500 and 600 copies; the average first-year sale of books published by university presses between 350 to 600 copies; and the ultimate sale from 900 to 1000. Mr. Marshall, after studying the histories of fifty-nine titles published by learned societies between 1923 and 1929, computes[7] the following averages:

Size of edition	1133	
Number of pages	266	
Manufacturing cost .	$1651	
Cost per copy	1.69	
Cost per page	5.89	(for whole edition)
Price per copy	4.80	
Price per page	.021	(for each book sold)
Copies sold	219	

These small sales certainly could not be expected to support publication at a price per page so nearly normal. Naturally, the publishing is not self-supporting. In fact, the figures show that the expenses of manufacture and administration involved in the publication of these fifty-nine titles ran to $115,000, while the net proceeds from sales to apply against these expenses came only to $41,000 in round numbers. The loss was, therefore, $74,000 on fifty-nine titles, or $1254 per book. Sixty-four per cent of the money came to these publishing projects as a subsidy. This is the ratio for publication by the learned societies themselves.

The costs and returns from a typical research book are shown in Table II on the following page.

It is to be expected that the learned societies would select for publication the titles least likely to have a wide sale. The general average for scholarly publication is computed by Mr. Bean to stand on a somewhat different level. He calculates that the proportion of publication cost met by subsidy is 35%.

It can be concluded that under present publishing practices, a sale of 600 copies will bring in 66% of the cost of publication; a sale of 200 copies will bring in 33% of the cost of publication; and that no book can be expected to get the publisher out of the red until after sales have passed well beyond the 1000 mark.

Mr. Cheney's estimates of average sales in commercial publishing (which includes some scholarly publishing) confirm these conclusions. Mr. Cheney finds that 58% of all fiction titles sell over 3000 copies, and 19% of all non-fiction titles sell over this amount. Of fiction titles the following distribution is normal:

9 books in 10 sell over 1,000
8 books in 10 sell over 1,500
7 books in 10 sell over 2,000
6 books in 10 sell over 2,500
5 books in 10 sell over 4,000
4 books in 10 sell over 5,000
2 books in 10 sell over 10,000
1 book in 10 sells over 20,000

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[7] This table refers only to books published by the Medieval Academy, not to the fifty-nine titles published by all learned societies.

TABLE II

A TYPICAL RESEARCH BOOK--COSTS AND RETURNS[*]

Price: retail	$2.75	($.016 per page)
members and booksellers	$2.20	($.013 per page)
Cost of manufacture:		
Composition	$418.00	
Alterations	112.15	
	530.15	(70% of total)
Presswork, paper, binding	242.00	(30% of total)
	$772.15	
Assignable costs of marketing	101.67	
	$873.82	
Receipts from the sale of 216 copies	503.88	(57% of costs)
Loss (not including overhead)	$369.94	

Costs per copy:

Costs	Sale of 500	300	216 (actual)
Manufacture	$1.54	$2.57	$3.57
Marketing	.46	.46	.46
Overhead	.30	.30	.30
	$2.30	$3.33	$4.33
Average return	2.30	2.33	2.33
Gain or loss	$ .03+	$1.00-	$2.00-

[*] A monograph of The Medieval Academy, published October 15, 1930.

Thus, everything points to the marked difference between scholarly and commercial publishing economy, because of the lack of a wide market for the tools and products of research scholarship.

The Volume of Scholarly Publishing

Mr. Bean has gathered figures which make it possible to put the quantity of scholarly book and periodical publishing in its financial perspective. The number of different printed books in existence has been estimated at twenty-four million titles. Mr. Richardson of the Library of Congress thinks there are eight million of these in American libraries. Every year approximately 150,000 new titles appear, about half of which possess some academic interest. Ten thousand of the 150,000 new books are published in America, and of these possibly one-half possess an element of interest to the scholar. But the number of works of pure research scholarship (including materials and tools of research) is much less than this. A count of the American books accessioned by the Library of Congress in 1927 shows that in that year only 1119 books were published for research scholars. This count excluded the many popularization textbooks and books of applied science.

There are about 20,000 periodicals, including newspapers, issued in the United States, and of these, according to Mr. Bean's calculations, 291 are important research journals issued by scholars for scholars. The output of the total publishing business in America, according to the census of manufacturing, runs to two and a half billion dollars a year. Book and pamphlet publishing is conducted at a cost of two hundred million dollars. But the cost of publishing these 1119 research books and 291 research journals is estimated by Mr. Bean at approximately six million dollars a year--three and a half million for books, and two and a half million for journals. Only 1 7/10% of the money spent for book and pamphlet publishing goes to publish research books and pamphlets. The cost of publishing for research scholars is only 1/4% of the publishing budget of the country. It is, therefore, inevitable that the main technical and business developments in publishing should follow other needs than those of research scholarship.

Nevertheless, the scholars are in a position to control their own part of the industry, for the funds for scholarly publishing are drawn almost exclusively from the scholars themselves, being paid directly or indirectly by the educational institutions of the country. Sixty-five per cent of the money received for the sale of research journals comes from the libraries together with the members of the societies who are for the most part salaried by the educational institutions. But the money received from sales does not defray the whole cost. In scholarly book publishing, 35% of the money is received in the form of subsidies which are in some cases paid directly by the institutions, in other cases by authors who are salaried by institutions.

Here are two great enterprises: the publishing trade with an annual budget of two and one-half billion dollars, and the colleges and universities with an annual budget of five or six hundred million. Their interests overlap in the small item of six million dollars' worth of scholarly research publishing. Organized scholarship can, if it will, bring this area completely under its own control. He who pays the piper can call the tune.

The Scholarly Market

There are no adequate statistics on library expenditures for research books, but a few figures are available to indicate the scale of library purchasing operations. The United States Office of Education reports that the total annual expenditure for books, pamphlets, and periodicals reported by public, school, college, and other libraries (totaling 5803 libraries) in 1929 was sixteen million dollars, of which almost fourteen million was spent for books published in America.[8] In 1931, library book-purchasing power was nineteen million dollars.[9] Most of this money is undoubtedly spent on books of little or no scholarly interest. Mr. James Thayer Gerould has kept records of the sums spent for acquisitions by forty of the larger university and college libraries. His figures, rounded out to thousands of dollars, stand as in Table III for the year 1930-31.

These forty libraries spent a total of $3,226,000 and added to their resources a total of 1,134,510 volumes in 1930-31. The list does not include certain

TABLE III

ACQUISITION SUMS SPENT BY FORTY OF THE LARGER UNIVERSITY AND COLLEGE LIBRARIES

Harvard	$365,000	Ohio	$79,000	Washington (St. Louis)	$36,000
Columbia	193,000	Wisconsin	70,000	Cornell	34,000
Chicago	184,000	Princeton	70,000	Virginia	33,000
Yale	183,000	Brown	67,000	Indiana	32,000
Duke	171,000	Western Reserve	59,000	Kansas	31,000
Illinois	134,000	Stanford	59,000	Oberlin	31,000
California	129,000	Washington (Seattle)	55,000	Missouri	26,000
Michigan	113,000	Texas	54,000	Wellesley	23,000
Minnesota	113,000	Iowa State	53,000	Vassar	23,000
Iowa	104,000	California (Los Angeles)	52,000	Smith	21,000
Northwestern	101,000	Oregon	45,000	Nebraska	20,000
Dartmouth	84,000	North Carolina	37,000	Bryn Mawr	19,000
Pennsylvania	83,000			North Dakota	10,000
Rochester	82,000				
Johns Hopkins	81,000				

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[8] Cheney, p. 311, refers to a special study of this point.

[9] Karl Brown, "Buying Power of Libraries," Publishers Weekly, June 20, 1931.

of the largest reference libraries in the country, such as the Library of Congress, the New York Public Library, or the John Crerar Library.

If each of these forty libraries buys every one of the research books (1119) published in a given year, and subscribes to all of the important research periodicals (291), the total amount carried on each budget for the support of American scholarly publishing is only $6350 per library, or a total of $254,000 toward the six-million-dollar publication bill.

The smaller university libraries and the medium or larger college libraries must, therefore, be reckoned as the main contributors to American scholarly publishing. Mr. Bean estimates that 975 such libraries are in the market for research books. A careful study of the budgets of about 200 of these smaller libraries has been made by Professor Randall of the University of Chicago.[10] His findings show that 205 college libraries spend every year for books $964,000; the average amount annually devoted to book purchase is $3900; the average number of books added to the library is 1500 titles per year. Mr. Randall thinks there are 600 libraries of this class. These studies suggest the conclusion that the lesser college libraries may be spending as much as three to four million dollars a year, but that the smaller colleges are often unable to provide adequate library facilities for instruction of students, and hence have little margin to be used in helping to finance the reproduction of research material.

Aside from the college libraries, there are many agencies which in special fields may help to defray the costs of scholarly publishing with their purchasing power. Mr. Franklin F. Holbrook's study,[11] compiled under the direction of the Joint Committee on Materials for Research, lists 458 agencies of which only a small proportion are college libraries, and of which many are active in acquiring research materials. Historical societies, law libraries, and special libraries of all kinds round out the institutional market for research publications.

Aside from the libraries of institutions, there is a market for scholarly publications among the scholars themselves. The Association of University Presses maintains cooperatively on addressograph plates an educational directory of 67,000 names, distributed about as follows:

Social Sciences	18,630
Humanities	21,192
Physical Sciences	8,520
Biological Sciences	17,412
College Presidents	1,277
	67,031

These lists are used by the various university presses in circularizing announcements of books. Presumably they constitute the active market list. Fifty great university and college libraries, a thousand small ones, several hundred other institutions, and 67,000 scholars--such is the market for scholarly publishing in America. It is here that the 200 to 600 copies of the scholars' research books find their sale.

Library Costs

The publishing cost and purchase price of the book are not the heaviest expenses that have to be met in making it available to a scholar in a library. Library finances must be given a place in the total picture, not only because the library is the agency through which the educational institutions pay 65% of the sales revenue, or 42% of the publishing bill, but also because the different methods of reproducing materials fit differently into the scheme of library finances.

The money spent by libraries for acquisitions is only a small part of the cost of maintaining the library system. The costs of putting books on the shelves, administering them, and housing them are greater than the costs of acquiring them.

The cost analysis of library administration is a disputed field, in which the files of the Library Journal report a prolonged controversy. The most active work in cost analysis has been applied to the study of cataloguing cost--the cost of putting the book on the shelves. The figures which seem best attested are those of the University of California--$.72 per book. Mr. Paul North Rice, a specialist in cooperative cataloguing, thinks that the real cost of putting a book on the shelves is between $1.50 and $2.00 per volume. Figures collected by the government show that university libraries spend from 50% to 72% of their funds for other than acquisition purposes. Cornell spends 50%, Yale spends 72%; the normal amount is about 66%.

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[10] William M. Randall, The College Library. A Descriptive Study of the Libraries in Four-Year Liberal Arts Colleges in the United States, (American Library Association and University of Chicago Press, 1932).

[11] Survey of Activities of American Agencies in Relation to Materials for Research in the Social Sciences and the Humanities, (New York and Washington, 1932).

Costs of administration are likely to be unusually high when the material cared for is not in normal book form. Manuscript and pamphlet collections and collections of ephemera are often made by libraries without the use of much purchase money, their cost being principally administrative.

The capital cost of housing a library is not included in this figure, since land and buildings are not often paid for out of current funds. The Cleveland Public Library, which pays for its main building out of revenue, finds that interest and twenty-five-year amortization on a four-million-dollar building, for which land was donated, take up 39% of the money, leaving 61% for book purchase and administration. If the cost of the land had been charged to the library, the percentage of revenue devoted to housing would have been nearer to 75%. The New York Public Library maintains an enormous investment in land and buildings. In libraries of this kind the increasing quantities of material and numbers of readers may call for the doubling of the plant every twenty years, and the housing cost may be more than double the administrative cost, or four times the cost of purchasing books. If a book costs $1.00, such a library must spend $2.00 to administer it and $4.00 to house it. A person who gives a book to a library under these conditions is really putting the library to an expense that may be six times the value of his gift. That this housing cost cannot be dismissed into the remote future but must be accepted as a normal element in library financing, is indicated in Mr. Randall's study of ninety-four college libraries. He found that forty-eight of these will be filled in ten years, and twenty-five within a five-year period. Out of 128 library buildings, sixty-four report either that they are already beyond their working capacities so far as stack space is concerned, or that they will be beyond them within ten years.

What is a normal cost-per-book for library buildings? It is often figured very roughly at $1.00 per volume; that is to say, a million dollars will buy a building to house a million volumes. But stack room is much cheaper than the building as a whole. The president of Snead and Company, specialists in library shelving problems, estimates the following:

> On the basis of present prices, library buildings can be put up at a cost of from $.40 to $.50 per cubic foot. The stack portion of a building without the stacks would probably cost from one-third to one-half of this figure. The equipment of the stack room would cost from $.30 to $.40 per cubic foot. In figuring stack room, a figure of about two and one-half volumes per cubic foot is approximately correct.

According to these figures, the cost of stack room per book would vary from $.062 to $.10, but the cost of equipment in the stack room would increase this by an amount anywhere from $.12 to $.16 per book. The total cost per volume stands, therefore, between $.18 and $.26 for stack room only. The difference between this figure and the "dollar-a-volume" estimate is accounted for by the requirements of space for administration, reading, and study.

Just as the manuscript or pamphlet collections cause an abnormally high administration cost, so newspaper collections cause an extraordinary housing charge. Shelving alone costs $1.00 per newspaper volume, and the cubic footage of stack space needed with the shelving runs this cost up to $2.00 or $3.00 per volume. This fact has an important bearing on the problem of preserving newspaper files, for it may be necessary to choose among preserving the existing paper stock, making photolithographic copies in reduced size on permanent paper, or making microcopies on film or glass. By reducing the size of the newspaper one-half, housing costs can be cut three-fourths or even more. Another point at which housing costs affect policies in the reproduction of research material appears in connection with the microcopy or filmslide. To the extent that the filmslide replaces the book, the housing costs become negligible. In the Library of Congress the visitor may see copies of a million manuscripts stored in filmslide form upon a few inconspicuous shelves.

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CHAPTER III

PRINTED BOOKS AND REPRINTS

The publishers of commercially successful books have very little occasion to study the cost curve of editions in the range of 50 to 500, yet it is this range in edition size that library demand and scholarly interest indicate as the most important in the reproduction of research materials. The cost curve behaves very strangely in this zone, so that the judgment of business men acquainted with large-edition printing may be of little value here. How can these costs be analyzed most clearly, and the respective places of the various techniques of book production determined?

The stages of book production separate costs into three primary elements: a "first cost," incurred regardless of the size of the edition; a "running cost," varying with the size of edition; and a "reprint cost," incurred when an edition is exhausted and a new printing made from plates. The reprint cost is independent of the size of the reprint edition; it is a kind of second "first cost," followed by a running cost that varies with the size of edition.

The first cost is itself divisible into two very important elements: composition costs, here defined as all costs that vary with the number of words; and area costs, which are those that vary with the area of paper used in a single copy. Composition costs are found in typewriting and linotyping; area costs are found in some of the pressroom operations. To print in large type rather than in small affects principally area costs, not composition costs, because it means spreading the same number of words over more paper; to reproduce by photolithography is to render area costs paramount elements of first cost. Reprint costs are affected in printing by storing type (rates running around $.01 per page per month), or by making stereotypes and electrotypes; in photo-offset, by saving the metal sheets; in mimeographing, by saving the stencils.

The librarian receives as a book any bound volume, however it may have been manufactured. Library shelves give their space to many bound volumes of photostated pages (mostly copies of rare books) and many bound volumes of typescript (mostly theses). Occasionally a bound volume produced by the mimeograph finds its way to the shelves. In recent years there have been a number of books produced by the photo-offset method from typescript master copies. Many reprints of old books are manufactured by photo-offset. Such parvenu volumes, invading the library shelves, are regarded with no little contempt by the exponents of established printing press products already in possession. How far are these different techniques suitable for the production of books? How is the field to be allotted among them?

Here it is necessary to note that the book itself is challenged, even in the library. The vertical file, housing an array of unbound memoranda, pamphlets, propaganda matter, broadsides, and other materials, some of permanent value and some ephemeral, has come into the library reference room to take business away from the bookshelves. And now from another quarter comes the possible development of reduced copies on film of material to be read by projection, threatening the books with more serious technological unemployment. Not only the ordinary printed book of the conventional form, but even the book itself is placed in a competitive position where it once possessed a monopoly. It will require no little care to make sure that competition between the book and its rivals is regulated in the best interests of scholarship.

The starting point of an analysis of the technological problem of book production is a fundamental distinction to be made between two types of cost behavior, instanced by the photostat on the one hand, the printing press on the other. When copies are multiplied by the photostat or in miniature film copies, no matter how large the edition, the cost per copy stands constant. The element of "first cost" is absent; running costs alone prevail. This was the cost situation of all multiplying of writing before Gutenberg. The invention of printing introduced a situation in which the cost per copy fell as the size of the edition increased. For purposes of convenience all those techniques which operate on a cost system resembling printing will be analyzed first, and those techniques which operate on or near a pre-Gutenberg cost basis will be analyzed later.

Of the techniques operating on the system resembling printing (i.e., with a substantial distinction between first costs and running costs), several classifications are possible. The one that will probably appeal to scholars as the most natural would distinguish between those techniques which produce a book printed in the kind of book type with which they are familiar, and those which produce a book printed in typescript.

Of the techniques yielding a product in print-face type, there are two that are available for putting new material into book form: these are printing from raised type on a flat-bed cylinder press, and printing from raised type on a multigraphing machine. Two other techniques are available for making new books from photographs of old ones. These are the photo-offset method, which has many names,[1] and the "dermaprint" method. The photo-offset process works from a negative photographic copy to a metal printing surface, the dermaprint from a positive photographic copy to a mimeograph stencil surface.

There are also four techniques for making books in typescript face. Among them the leading place belongs to photo-offset, but room must also be found for the mimeograph, hectograph, and even the humble carbon paper. These techniques will be discussed in a later chapter. This present analysis is limited to the discussion of making books in ordinary print type from one of two kinds of copy--a manuscript that is being converted into a new book, and an old book that is being reprinted.

Printing with Raised Type on Cylinder Presses

From the time of John Gutenberg until that of Ottmar Mergenthaler, the process of printing remained fundamentally the same. Separate types, laboriously set up by hand, were used to make impressions upon paper or other substances. With the invention of the typesetting and typecasting machines in the nineteenth century, however, a revolution in printing methods was effected.

The most common typesetting machines, remarkable in their ingenious mechanism, are the linotype, invented by Mergenthaler, and the intertype, built upon the mechanical principles devised by him. These machines, which produce the greater percentage of composition in this country, assemble matrices containing the faces of letters in intaglio at the side of a mold, in which is cast the complete line in one piece or slug, with the type on the upper edge, properly spaced and justified. The Ludlow Typograph, another slug-casting machine, is used chiefly for display work. The monotype, invented by Tolbert Lanston, casts individual types in the correct order and automatically transfers them to a galley in justified lines.

The type as cast by the compositor is arranged in long columns. These must be proofread and "made-up," that is to say, divided into pages and arranged in forms in such a way that the printed sheet, when folded, will page correctly.

The printing is then done on a flat-bed cylinder press. The type as laid on the flat surface, with its thousands of slugs and individual types, does not present a true surface. It is, therefore, necessary to prepare the surface of the printing machine cylinder (called the tympan sheet) so that even pressure is given on every part of the type. This operation, which is a most laborious affair if conscientiously done, is called "make-ready." Without careful make-ready, satisfactory

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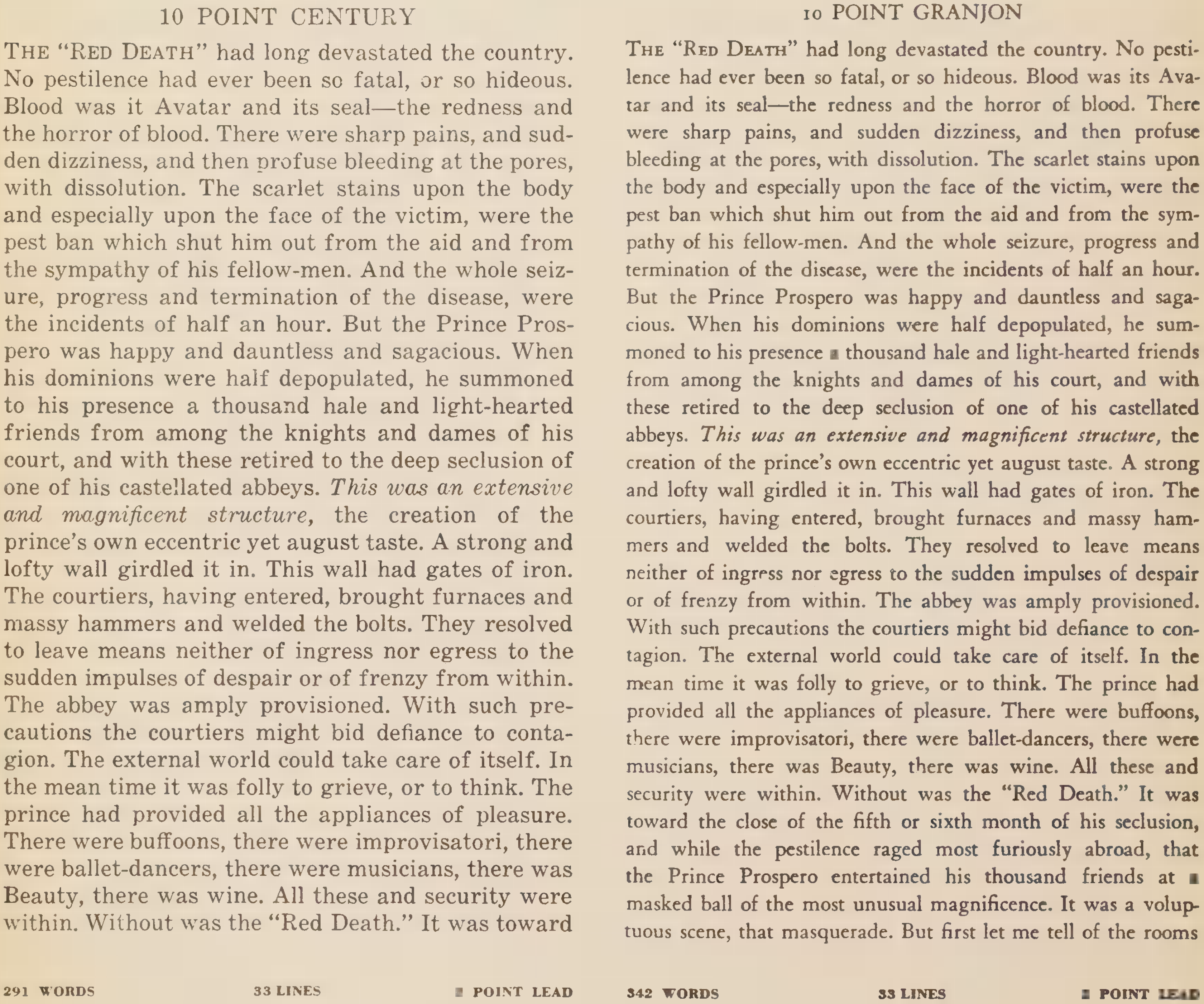
[1] Planographing (which includes hectographing), photolithography, lithoprinting, offset printing, "copifyer" process, rotaprinting, offset lithography, repro-printing, photocopying, photoprinting, polyprinting, planoprinting, and multilithing.

FIGURE I

This figure, showing a page of 10-point Century and a page of 10-point Granjon, both leaded two points, gives a comparison of the varying word content made possible by the use of different type faces of the same point size. These pages were reproduced from the Wolff Type Book with the kind permission of the Wolff Book Manufacturing Company.



10 POINT CENTURY

THE "RED DEATH" had long devastated the country. No pestilence had ever been so fatal, or so hideous. Blood was it Avatar and its seal—the redness and the horror of blood. There were sharp pains, and sudden dizziness, and then profuse bleeding at the pores, with dissolution. The scarlet stains upon the body and especially upon the face of the victim, were the pest ban which shut him out from the aid and from the sympathy of his fellow-men. And the whole seizure, progress and termination of the disease, were the incidents of half an hour. But the Prince Prospero was happy and dauntless and sagacious. When his dominions were half depopulated, he summoned to his presence a thousand hale and light-hearted friends from among the knights and dames of his court, and with these retired to the deep seclusion of one of his castellated abbeys. *This was an extensive and magnificent structure,* the creation of the prince's own eccentric yet august taste. A strong and lofty wall girdled it in. This wall had gates of iron. The courtiers, having entered, brought furnaces and massy hammers and welded the bolts. They resolved to leave means neither of ingress nor egress to the sudden impulses of despair or of frenzy from within. The abbey was amply provisioned. With such precautions the courtiers might bid defiance to contagion. The external world could take care of itself. In the mean time it was folly to grieve, or to think. The prince had provided all the appliances of pleasure. There were buffoons, there were improvisatori, there were ballet-dancers, there were musicians, there was Beauty, there was wine. All these and security were within. Without was the "Red Death." It was toward

291 WORDS **33 LINES** **2 POINT LEAD**

10 POINT GRANJON

THE "RED DEATH" had long devastated the country. No pestilence had ever been so fatal, or so hideous. Blood was its Avatar and its seal—the redness and the horror of blood. There were sharp pains, and sudden dizziness, and then profuse bleeding at the pores, with dissolution. The scarlet stains upon the body and especially upon the face of the victim, were the pest ban which shut him out from the aid and from the sympathy of his fellow-men. And the whole seizure, progress and termination of the disease, were the incidents of half an hour. But the Prince Prospero was happy and dauntless and sagacious. When his dominions were half depopulated, he summoned to his presence a thousand hale and light-hearted friends from among the knights and dames of his court, and with these retired to the deep seclusion of one of his castellated abbeys. *This was an extensive and magnificent structure,* the creation of the prince's own eccentric yet august taste. A strong and lofty wall girdled it in. This wall had gates of iron. The courtiers, having entered, brought furnaces and massy hammers and welded the bolts. They resolved to leave means neither of ingress nor egress to the sudden impulses of despair or of frenzy from within. The abbey was amply provisioned. With such precautions the courtiers might bid defiance to contagion. The external world could take care of itself. In the mean time it was folly to grieve, or to think. The prince had provided all the appliances of pleasure. There were buffoons, there were improvisatori, there were ballet-dancers, there were musicians, there was Beauty, there was wine. All these and security were within. Without was the "Red Death." It was toward the close of the fifth or sixth month of his seclusion, and while the pestilence raged most furiously abroad, that the Prince Prospero entertained his thousand friends at a masked ball of the most unusual magnificence. It was a voluptuous scene, that masquerade. But first let me tell of the rooms

342 WORDS **33 LINES** **2 POINT LEAD**

Sample Page to Illustrate Letterpress Format on 6¾″x9½″ Page

AN ECONOMICAL PRINT-FACE FORMAT

In order to secure an economical print-face format, various factors must be taken into consideration. Among these are the compactness and size of the type-face, the amount of leading, and the width of the margins.

In discussing type-sizes and type-faces, it may be well to know of the graduated or uniform scale for measuring type which is now used by American type-founders. This scale is known as the point system. The unit of the system is a division of space called a point, which is .013837 or 1/72 of an inch. All type sizes are multiples of this unit of measurement. The smallest type generally used is 5-point or Pearl. 6-point or Nonpareil and 8-point or Brevier are frequently used for footnotes in monographic work. 7-point or Minion is commonly used for newsprint. 10-point or Long Primer is best suited for regular book composition. Examples of these type-sizes can conveniently be found by looking under "type" in *Webster's International Dictionary of the English Language.* The use of a type-size smaller than 10-point effects an economy in make-up and make-ready but not in composition, for a given manuscript will require approximately the same number of "ems" in various sizes of type.

As a given font of type has an exact point-size in its depth, so the individual characters of that font have a definite width of "set." The average width of the character "m" in a type-face is as great as its depth; in a word, the letter "m" is exactly square. This is the case in commonly used type-faces like Caslon Old Style, Scotch Roman and Modern, where in 10-point the set size of the letter "m" is also 10 points. In a compact type-face, like the one used for this composition, the set size of the letter "m" is only 9½ points, with all other characters having a corresponding compactness. By the use of this type-face, known as Granjon, a considerable saving can be effected in composition costs if these are reckoned up by multiplying the width by the length of the line. If composition costs are determined by the number of key-strokes instead of the amount of type matter, this type-face would effect a saving not in composition costs, but in area costs only.

Excessive leading is not compatible with good value in book-making, and should be prevented, if possible, by instructions by the publisher to the printer. The type of this page is leaded one point; in a word, 11-point type is cast on a 12-point body.

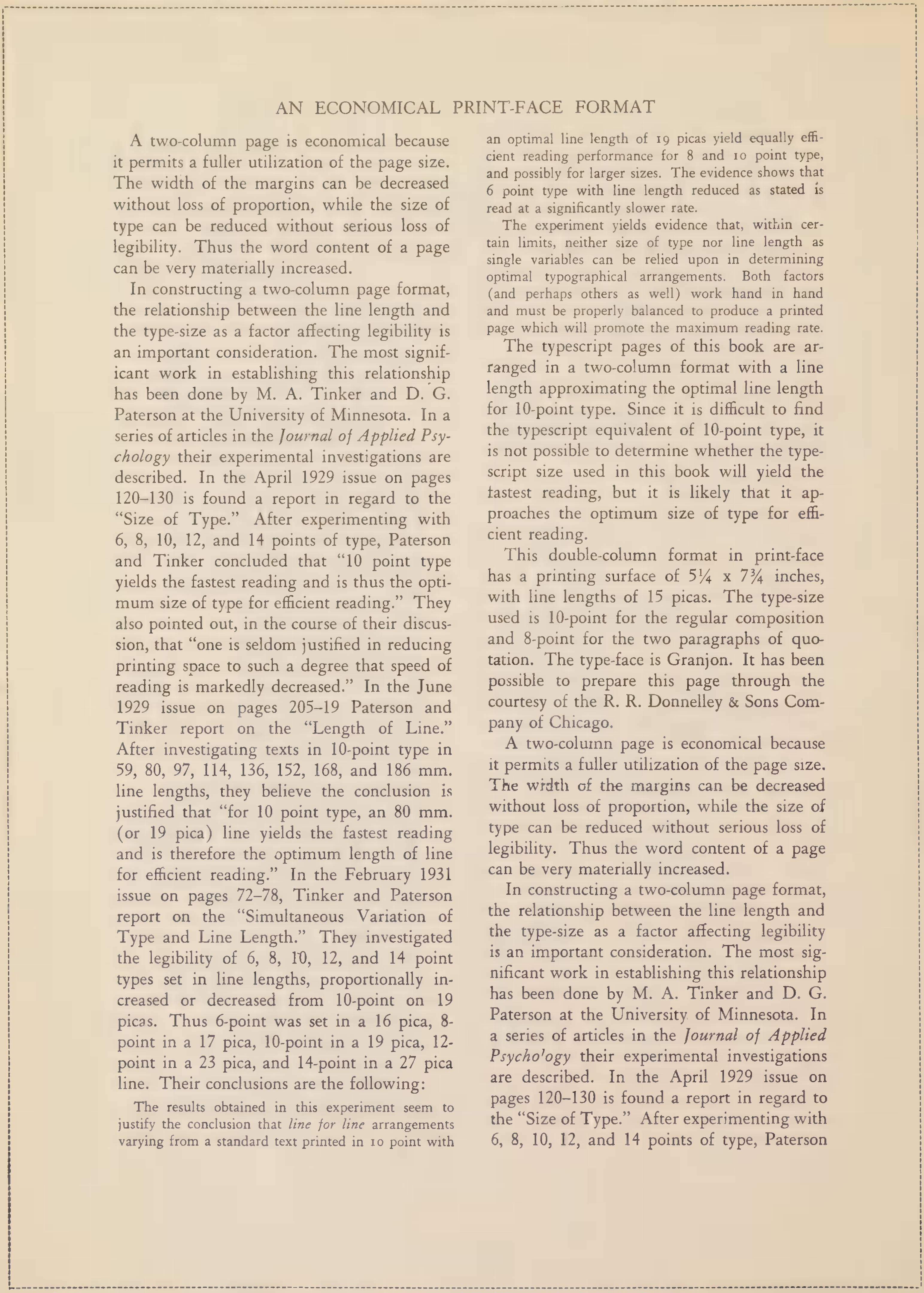
Much space is often wasted in margins. The formula for margins given by Gress[1] calls for top and back margin to be equal; the outside to be equal to the top plus one-third of the back margin; and the bottom to be equal to the outside margin plus two picas (or about one-fourth inch). This formula is followed in the format here illustrated.

This page format has been designed by the R. R. Donnelley & Sons Company of Chicago as one taking account of the economies possible in page

[1] W. B. Gress, *Advanced Typography* (Washington, 1931), p. 125.

FIGURE II

Sample Page to Illustrate Letterpress Format on 6¾″x9½″ Page



AN ECONOMICAL PRINT-FACE FORMAT

A two-column page is economical because it permits a fuller utilization of the page size. The width of the margins can be decreased without loss of proportion, while the size of type can be reduced without serious loss of legibility. Thus the word content of a page can be very materially increased.

In constructing a two-column page format, the relationship between the line length and the type-size as a factor affecting legibility is an important consideration. The most significant work in establishing this relationship has been done by M. A. Tinker and D. G. Paterson at the University of Minnesota. In a series of articles in the *Journal of Applied Psychology* their experimental investigations are described. In the April 1929 issue on pages 120–130 is found a report in regard to the "Size of Type." After experimenting with 6, 8, 10, 12, and 14 points of type, Paterson and Tinker concluded that "10 point type yields the fastest reading and is thus the optimum size of type for efficient reading." They also pointed out, in the course of their discussion, that "one is seldom justified in reducing printing space to such a degree that speed of reading is markedly decreased." In the June 1929 issue on pages 205–19 Paterson and Tinker report on the "Length of Line." After investigating texts in 10-point type in 59, 80, 97, 114, 136, 152, 168, and 186 mm. line lengths, they believe the conclusion is justified that "for 10 point type, an 80 mm. (or 19 pica) line yields the fastest reading and is therefore the optimum length of line for efficient reading." In the February 1931 issue on pages 72–78, Tinker and Paterson report on the "Simultaneous Variation of Type and Line Length." They investigated the legibility of 6, 8, 10, 12, and 14 point types set in line lengths, proportionally increased or decreased from 10-point on 19 picas. Thus 6-point was set in a 16 pica, 8-point in a 17 pica, 10-point in a 19 pica, 12-point in a 23 pica, and 14-point in a 27 pica line. Their conclusions are the following:

> The results obtained in this experiment seem to justify the conclusion that *line for line* arrangements varying from a standard text printed in 10 point with an optimal line length of 19 picas yield equally efficient reading performance for 8 and 10 point type, and possibly for larger sizes. The evidence shows that 6 point type with line length reduced as stated is read at a significantly slower rate.
>
> The experiment yields evidence that, within certain limits, neither size of type nor line length as single variables can be relied upon in determining optimal typographical arrangements. Both factors (and perhaps others as well) work hand in hand and must be properly balanced to produce a printed page which will promote the maximum reading rate.

The typescript pages of this book are arranged in a two-column format with a line length approximating the optimal line length for 10-point type. Since it is difficult to find the typescript equivalent of 10-point type, it is not possible to determine whether the typescript size used in this book will yield the fastest reading, but it is likely that it approaches the optimum size of type for efficient reading.

This double-column format in print-face has a printing surface of 5¼ x 7¾ inches, with line lengths of 15 picas. The type-size used is 10-point for the regular composition and 8-point for the two paragraphs of quotation. The type-face is Granjon. It has been possible to prepare this page through the courtesy of the R. R. Donnelley & Sons Company of Chicago.

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In constructing a two-column page format, the relationship between the line length and the type-size as a factor affecting legibility is an important consideration. The most significant work in establishing this relationship has been done by M. A. Tinker and D. G. Paterson at the University of Minnesota. In a series of articles in the *Journal of Applied Psychology* their experimental investigations are described. In the April 1929 issue on pages 120–130 is found a report in regard to the "Size of Type." After experimenting with 6, 8, 10, 12, and 14 points of type, Paterson

FIGURE III

results are unobtainable.

Printing: Composition Costs

In printing from raised type on flat-bed cylinder presses, composition costs form a major item of expense in the manufacture of a book. To be sure, the composing machines, by increasing the speed and accuracy of composition, have reduced its cost, so that hand-set type, when used in straight textual matter, has become a luxury. But the elaborate mechanism necessary for casting type makes the cost of the machines so high (from $4000 to $8000) that a heavy overhead charge is necessary. The all-inclusive cost per chargeable hour for the operation of the machines range from $3.00 to $5.00. The composite average for print shops in the United States in 1932 was $3.927, according to the United Typothetae of America. The composite for monotype keyboard operation was $3.466, and for the monotype caster $2.858. These figures include all factory expenses, commercial and selling expenses, overhead, and the wages of skilled compositors, which form 45% of the total. In estimating the cost of composition, a standard unit of 1000 ems is used; that is, the amount of text that will occupy the lineage of a thousand of the letter m, or, to be more accurate, the square of any particular type size. If the number of ems per word is calculated at four, there would be 250 words per 1000 ems. Since a compositor will set from 3000 to 5000 ems per hour, the cost of machine composition, reckoning on the basis of $3.00 to $5.00 per machine hour, would run between $2.40 and $6.65 per 1000 words.

Theoretically, the amount of composition is determined by multiplying the number of ems in one line by the number of lines set. It is the general trade practice, however, in measuring up type for the purpose of finding the cost of composition, to include headings, leads, slugs, etc., as composed lines.[2] Thus the number of ems in the page is found by multiplying the width by the length of the line. The author, therefore, pays in composition for excessive leading. The majority of books appear in 10-point type on 11-point body, the majority of newspapers in 6 1/2-point or 7-point type on 7-point body. For each additional point of leading the author ordinarily pays about 10% more in composition. It is questionable whether legibility demands more than one point of lead between lines. Certainly types like Caslon Old Style, with its long descenders, can be sparsely leaded without suffering in legibility.

Composition costs can be controlled in some measure by using a compact type face. Most of the commonly used type faces, like Caslon Old Style, Scotch Roman and Modern, have a set corresponding to the face size, that is, an em of these type faces is square; others, like Binny Old Style and Century Expanded, are used at a slightly wider set; while others, like Bruce Old Style, Kennerley, Garamond, and Granjon, are cast on a slightly narrower set. Thus a page of a certain number of ems of Granjon would contain 7% to 10% more words than a corresponding page with the same number of ems of Century Expanded, as is obvious by comparing the word content of Figure I. Two economical print-face formats are shown in Figures II and III.

The difference in words per 1000 ems between a compact and expanded type face, plus the difference between minimal and excessive leading, may make an appreciable difference in composition costs for a book of a few hundred pages, perhaps as much as 10% or 20%.

Most of the printing done in America is newsprinting. The American public reads more words in newsprint than in any other form. The publication of scholarly books, if estimated in number of ems, or area of pages, or tonnage of paper and size of edition, is almost negligible in comparison with the corresponding newsprint figures. Yet books, in general, are printed in larger type than newspapers, and with a layout that devotes a much larger proportion of the page area to margins. Newsprint in two-inch columns, as standardized in the American press, is certainly a format of remarkable cheapness and efficiency.

As a factor increasing composition costs, corrections and alterations deserve particular attention. From a description of the typesetting machines, especially the linotype and intertype, it is obvious that making corrections in the matter already set up is a costly operation, because each error requires the substitution of an entire line. With the monotype, corrections are somewhat cheaper, for only a single letter, already cast, need be substituted.

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[2] Some firms, like R. R. Donnelley and Sons Company, have adopted the scientific method of measuring composition by computing the actual number of ems set.

After composition has been made to correspond to the copy, all changes subsequently made by the author or his publisher, whether in the text or in the arrangement of paragraphs, are considered as author's alterations and are charged against him. Not infrequently the author is presented with a bill for his alterations almost equaling that of the original composition costs. Author's alterations are usually charged on the basis of time at the rate of about $2.00 to $4.00 per hour, varying with the wage scale, and higher when made by machine than when made by hand. In some cases alterations are billed on a unit basis with standard unit prices for changes, which enable the customer to check his bill. In some cases a free allowance, possibly 10% above the original composition, is made by the printer for author's alterations, which means simply that this factor has been figured into the original bid.

Author's corrections would be entirely unnecessary if the author would devote the same attention to the preparation of copy as he would to making a master copy for photo-offset, and be equally satisfied to accept this as a final form. By deliberately preparing a manuscript which would justify the instruction to "follow copy," the author would contribute to a low cost level in ordinary printing in the same way, though in a less degree, as by taking upon himself the making of the master copy for the photo-offset process. Some editors affirm that authors are so given to habits of carelessness that reform in this respect is possible only by changing human nature.

Printing: Area Costs

As in the case of composition costs, it is difficult for the author to control area costs in raised type printing. Area costs consist of make-up and make-ready. These operations increase in cost with the number of pages, but also greatly increase whenever it is necessary to fit type around pictorial or non-textual matter during make-up, or whenever the tympan sheet on the press must be prepared for pictorial matter during make-ready.

The fundamental unit of all area costs in raised type printing is the form or signature. The form is the area of type that fills the bed of the press, and is imposed upon the paper in one printing operation. The signature is the sheet of paper, printed on both sides, which is folded into a definite number of pages--usually sixteen or thirty-two. The area costs of printing mount form by form and signature by signature. It is wasteful of area to utilize only a portion of a form or to leave part of a signature unprinted. Printing economy always requires that there be such a calculation of type face, type size, and leading that the text comes out even with the forms and signatures. Just as ems, not words, are the main cost units in composition, so forms and signatures, not pages, are the determining quantities in area costs.

The amount of space a manuscript will occupy can be calculated either by counting the number of words in a sufficient number of lines and then multiplying by the number of lines, or by figuring the number of letters or words to the square inch. The average typewriter, with pica type, writes sixty letters single-spaced and thirty letters double-spaced; and with elite type writes seventy-two letters single-spaced and thirty-six letters double-spaced to the square inch. The average print-face type, on the other hand, has approximately the following number of letters to the square inch:

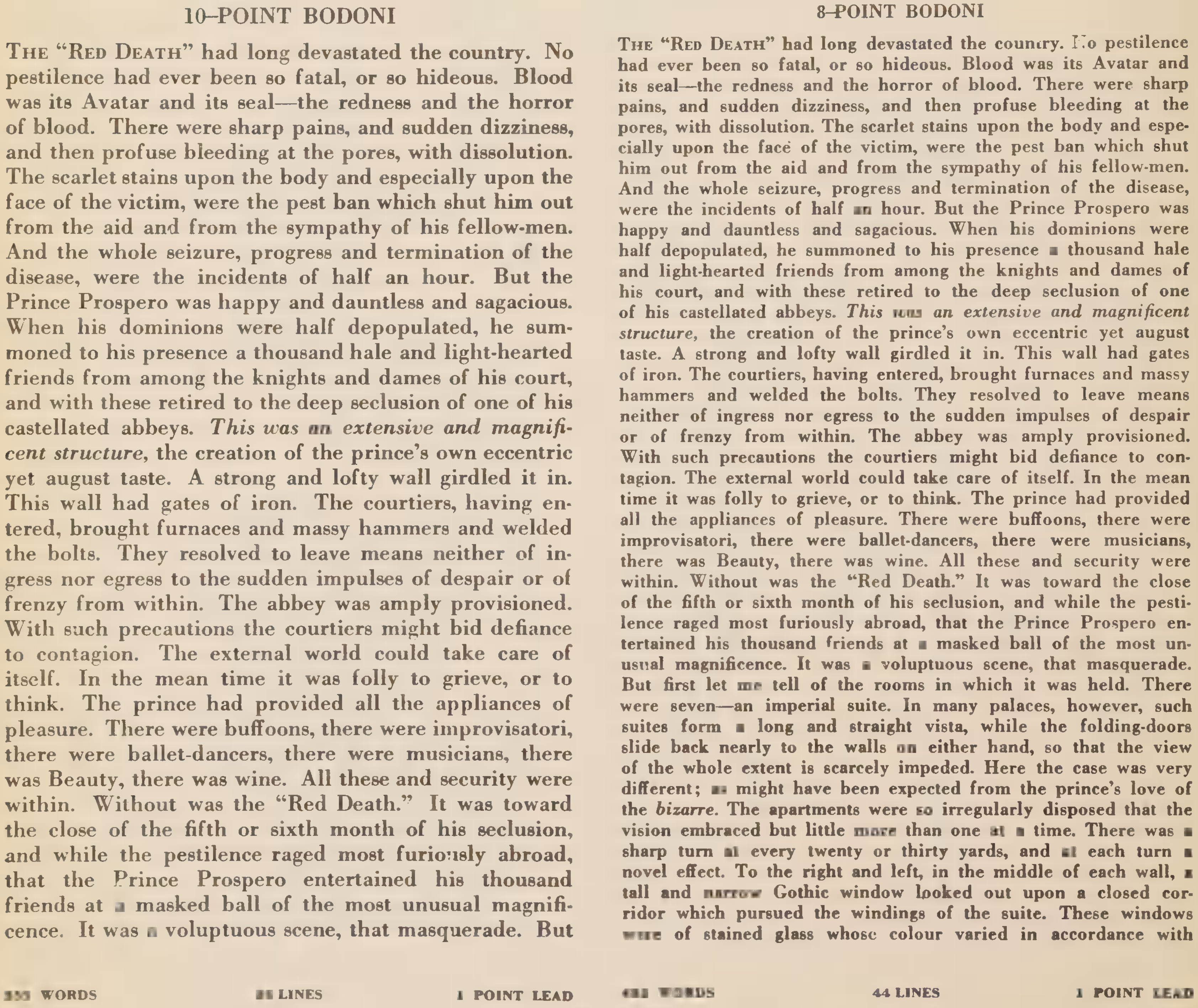
Size of Type	Solid	Leaded
6-point	204	153
8-point	153	119
10-point	98	84
12-point	72	60

The average print-face type, moreover, has approximately the following number of words to the square inch:

Size of Type	Solid	Leaded
6-point	47	34
8-point	32	23
10-point	21	16
12-point	14	11

FIGURE IV

This figure, showing a page of 8-point Bodoni and a page of 10-point Bodoni type, both leaded one point, gives a comparison of the varying word content made possible by the use of different size type in the same face. These pages were reproduced from the Wolff Type Book with the kind permission of the Wolff Book Manufacturing Company.



10–POINT BODONI

THE "RED DEATH" had long devastated the country. No pestilence had ever been so fatal, or so hideous. Blood was its Avatar and its seal—the redness and the horror of blood. There were sharp pains, and sudden dizziness, and then profuse bleeding at the pores, with dissolution. The scarlet stains upon the body and especially upon the face of the victim, were the pest ban which shut him out from the aid and from the sympathy of his fellow-men. And the whole seizure, progress and termination of the disease, were the incidents of half an hour. But the Prince Prospero was happy and dauntless and sagacious. When his dominions were half depopulated, he summoned to his presence a thousand hale and light-hearted friends from among the knights and dames of his court, and with these retired to the deep seclusion of one of his castellated abbeys. *This was an extensive and magnificent structure*, the creation of the prince's own eccentric yet august taste. A strong and lofty wall girdled it in. This wall had gates of iron. The courtiers, having entered, brought furnaces and massy hammers and welded the bolts. They resolved to leave means neither of ingress nor egress to the sudden impulses of despair or of frenzy from within. The abbey was amply provisioned. With such precautions the courtiers might bid defiance to contagion. The external world could take care of itself. In the mean time it was folly to grieve, or to think. The prince had provided all the appliances of pleasure. There were buffoons, there were improvisatori, there were ballet-dancers, there were musicians, there was Beauty, there was wine. All these and security were within. Without was the "Red Death." It was toward the close of the fifth or sixth month of his seclusion, and while the pestilence raged most furiously abroad, that the Prince Prospero entertained his thousand friends at a masked ball of the most unusual magnificence. It was a voluptuous scene, that masquerade. But

355 WORDS [illegible] LINES 1 POINT LEAD

8–POINT BODONI

THE "RED DEATH" had long devastated the country. No pestilence had ever been so fatal, or so hideous. Blood was its Avatar and its seal—the redness and the horror of blood. There were sharp pains, and sudden dizziness, and then profuse bleeding at the pores, with dissolution. The scarlet stains upon the body and especially upon the face of the victim, were the pest ban which shut him out from the aid and from the sympathy of his fellow-men. And the whole seizure, progress and termination of the disease, were the incidents of half an hour. But the Prince Prospero was happy and dauntless and sagacious. When his dominions were half depopulated, he summoned to his presence a thousand hale and light-hearted friends from among the knights and dames of his court, and with these retired to the deep seclusion of one of his castellated abbeys. *This was an extensive and magnificent structure*, the creation of the prince's own eccentric yet august taste. A strong and lofty wall girdled it in. This wall had gates of iron. The courtiers, having entered, brought furnaces and massy hammers and welded the bolts. They resolved to leave means neither of ingress nor egress to the sudden impulses of despair or of frenzy from within. The abbey was amply provisioned. With such precautions the courtiers might bid defiance to contagion. The external world could take care of itself. In the mean time it was folly to grieve, or to think. The prince had provided all the appliances of pleasure. There were buffoons, there were improvisatori, there were ballet-dancers, there were musicians, there was Beauty, there was wine. All these and security were within. Without was the "Red Death." It was toward the close of the fifth or sixth month of his seclusion, and while the pestilence raged most furiously abroad, that the Prince Prospero entertained his thousand friends at a masked ball of the most unusual magnificence. It was a voluptuous scene, that masquerade. But first let me tell of the rooms in which it was held. There were seven—an imperial suite. In many palaces, however, such suites form a long and straight vista, while the folding-doors slide back nearly to the walls on either hand, so that the view of the whole extent is scarcely impeded. Here the case was very different; as might have been expected from the prince's love of the *bizarre*. The apartments were so irregularly disposed that the vision embraced but little more than one at a time. There was a sharp turn at every twenty or thirty yards, and at each turn a novel effect. To the right and left, in the middle of each wall, a tall and narrow Gothic window looked out upon a closed corridor which pursued the windings of the suite. These windows were of stained glass whose colour varied in accordance with

[illegible] WORDS 44 LINES 1 POINT LEAD

ERRATA

Page 17, first column, twelfth line from the bottom which now reads "...would yield 800 pages, 24,600 words", should read, "...would yield 800 words per page, 24,600 words....".

The number of pages, and hence the number of forms, required will vary with the point size of the type, the compactness of the type, and the amount of leading.

An important difference is to be noted in the effect upon costs of faces and compactness of type on the one hand, and point size on the other. True it is that resort to compact type faces and light leading will mean fewer pages and hence fewer forms than extended faces and heavy leading. But the greatest difference in area costs is a resultant of two other factors--the proportion of paper given to text as compared with the proportion given to margins, and the point size of type. These elements of cost, more than any others, are likely to be related most directly to the beauty and legibility of text.

According to Vernon,[3] there is no great variation in legibility between 6-point type and 10-point type. Readers and reviewers, however, often express preference for the larger type sizes, and their preferences, even if they be regarded as the results of habit rather than the consequences of the physiology of vision, must be taken into account by a publisher. How far it is wise to let considerations of economy in area costs bring about the use of the smaller type sizes must be calculated by comparing two quantities: namely, the percentage of cost saving that can be effected by shifting from the largest to the smallest type, and the sacrifice of legibility or beauty that results from such a shift.

How rapidly will area costs fall if type size is reduced? Consider a 6" x 9" page, with a printing surface 4 1/2" x 7 1/2", printed with 32-page forms. Newsprint in two columns with half an inch between them would yield 800 pages, 24,600 words per form (according to an actual count of words). Eight-point type, leaded one point would put 25,000 words on a form; 10-point type in the same type face, leaded one point, would put 17,500 words on a form. Figure IV shows the increase in word content per page that is made possible by shifting from 10-point Bodoni type to 8-point Bodoni, both being leaded one point. The shift from 10-point to 8-point type would save one form out of three, or one-third of the area cost in a text of 50,000 words.

Printing: Running Costs

Running costs are not decisive in small editions. The difference between the cost of printing 50 and 100 copies is so small that firms often quote the same price for both. It is thus possible to have an overprint, which can be left in sheets until needed, at a very slight additional cost. Even with books of larger editions this procedure is followed. The Encyclopedia Britannica, for example, is printed in lots of 15,000, but is bound in lots of 2500 only. Electrotypes are made which are preserved for further printing, and the type is kept standing for making corrections and for making new electrotypes.

As the size of the edition increases to the point where composition and make-ready costs begin to be balanced by the cost of materials and running time in the press, the established conceptions covering book costs become operative. Many of the great inventions in the printing world since the Linotype have been devices of one kind or another for getting the printing surface on a cylinder and off the flat-bed, so that faster running and longer runs would be possible. This is the story of the stereotype, cast from a matrix, and of the electrotype, resulting from coating an impression in wax electrolytically with copper. But they have no place in the calculations of costs of small editions.

Printing: Analysis of Costs

In analyzing the composition, the area, and the running costs for producing a book by straight printing, one might take the cost behavior in Chicago as an example. A book of 50,000 words in an edition of 250, on 128 6" x 9" pages, could be made for $246.57. Taking these figures as an illustrative sample, it appears that for composing and printing a book, about 50% of the cost goes for composition, about 32% for make-up, 12% for make-ready, and 6% for actual printing in a minimum edition. There is, however, great dissimilarity in the amount which the different departments contribute to the cost of the finished product in various shops of the country.

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[3] M. D. Vernon, Experimental Study of Reading, (Cambridge, Massachusetts, 1931).

For hour costs of composing 50,000 words at a composite rate of $3.55 per hour for Chicago printers, without allowance for profit, the total would be	$127.50
For hour costs of printing 250 impressions, the time allowed per form being .35 hours according to Hoch,[4] or a total of 2.80 hours, at a composite rate of $4.90 per hour for flat-bed cylinder presses for Chicago printers, without allowance for profit, the total would be	13.72
For wages at the prevailing rate of $1.225 per hour in 1922 for make-up and lock-up, the time required for eight 16-page forms being 64 hours, the total wage bill would be	78.40
For wages at the prevailing rate of $1.225 per hour in 1933 for make-ready, the time required for a book of 128 pages, for which eight forms of 16 pages would be necessary, a deduction of .5 hours from the first make-ready time of 3.3 hours being allowed for the seven repetitive forms, the time required being 22 hours, the total wage bill would be	26.95
	$246.57

In general, the wages paid to skilled labor for composition work and for make-up and make-ready must account for a large part of the printer's bill. The averages of the United Typothetae of America show that wages account for approximately 45% of the cost of printing. Wages constantly increase in proportion to the total cost of production as the size of the edition decreases. The printing and publishing business, which is under the same pressure as other industries toward decentralization away from the big cities, can be expected to decentralize most rapidly its small-edition publishing. There is now setting in a contrary pressure toward the standardization of wages, but unless the regional and urban-rural differentials are closed up, small-edition publishing can be expected to drift to the low-wage areas.

The Multigraph Process

In multigraphing, the scholar encounters the curious situation that while he is trying to find an economical means of making small runs that will look like printing rather than typescript, the business man is trying to make large runs that will look like typescript rather than print. The multigraph (Figure V) is a small rotary printing machine designed for office use and employed chiefly for printing form letters and circulars of one or more pages in imitation of typescript and for making office forms from print-face type in imitation of printing.[5]

The best adaptation of multigraph

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[4] Fred Hoch, Standard Book of Estimating for Printers (Chicago, 1929) issued by the United Typothetae of America.

[5] Loose type, milled linotype slugs, special monotype composition, automatically embossed aluminum type strips or curved plates or electrotypes are mounted on the printing cylinder by sliding them into fixed grooves. Loose type, which is the most commonly used, is set semi-automatically by hand or with a typesetting machine operated with typewriter control. As in the case of typewriting, the right-hand margins come out uneven, unless they are justified by hand or with special adjustable spacers. The type is obtainable in a wide variety of sizes and standard print-faces, and costs $.80 for typewriter styles, $.95 for print styles, for a box containing on an average 25,000 characters, printing about 415 words; it is scrapped after using. It is sometimes mounted on a flexible blanket which may easily be attached to or removed from a smooth-faced segment. The embossed strips are always mounted on a similar sort of blanket. The most popular multigraph prints only one 8 1/2" x 11" page at a time, but a machine is manufactured with a drum large enough for two 8 1/2" x 11" pages; this is fairly common.

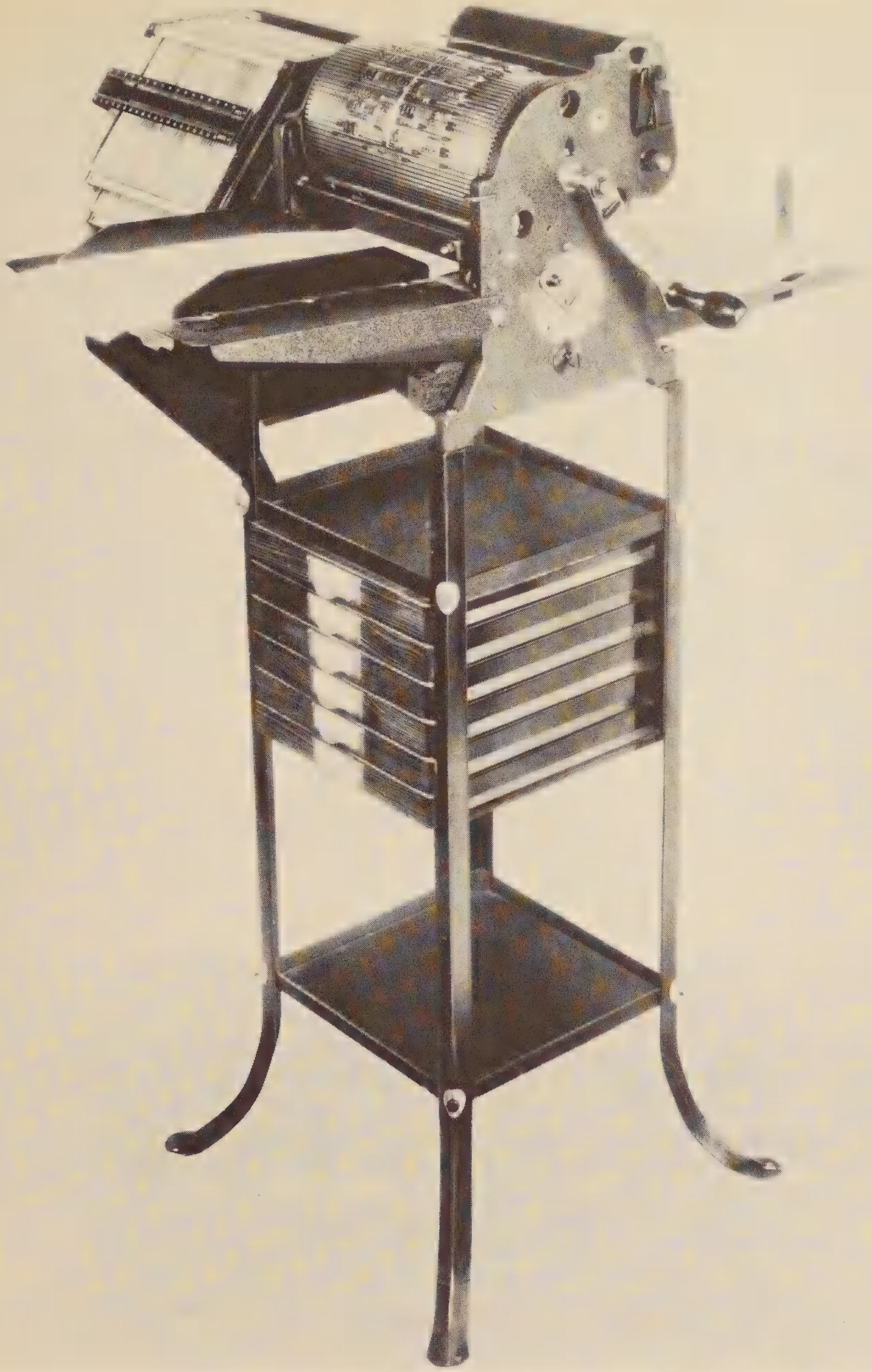

FIGURE V

Model 100 Multigraph

AN ECONOMICAL MIMEOFORM FORMAT
(Paper size 6 x 9 inches)
(12 pt. type)

The Multigraph, employed chiefly for printing form letters, becomes a factor in the field of reproduction, when used in combination with type-setting machinery.

The best adaptation in the field of reproduction has been made by Mimeoform Press, 1320 F Street, N. W., Washington, D. C., under the direction of Mr. Ernest Kletsch, who styles his process the Mimeoform Process. Mr. Kletsch uses a Lanston monotype for setting type, with a special take off, which delivers the line of short type, properly spaced and justified, to the channels of the multigraph drum in **page form**, doing away with galley proof. Proof reading done, corrections are quickly made away from caster. Type-setting is combined with make-up, and running costs, in small editions, are smaller than the cost of making signatures for the flat-bed press; the Mimeoform Process, therefore, is the cheapest method of presenting textual matter in print-face type, in editions up to five hundred.

Publishing by Mimeoform Process demands spacing of **six lines to the inch regardless of type size** (8, 10, and 12 point). Illustrations, even half tones can be combined with text at no greater cost than for printing, if curved plates are provided. The most economical Mimeoform format is an 8-1/2" by 11" page, set in ten-point type.

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AN ECONOMICAL MIMEOFORM FORMAT

(Paper size 6 x 9 inches)
(8 pt. type)

The Multigraph, employed chiefly for printing form letters, becomes a factor in the field of reproduction, when used in combination with type-setting machinery.

The best adaptation in the field of reproduction has been made by Mimeoform Press, 1320 F Street, N. W., Washington, D. C., under the direction of Mr. Ernest Kletsch, who styles his process the Mimeoform Process. Mr. Kletsch uses a Lanston monotype for setting type, with a special take off, which delivers the line of short type, properly spaced and justified, to the channels of the multigraph drum in **page form**, doing away with galley proof. Proof reading done, corrections are quickly made away from caster. Type-setting is combined with makeup, and running costs, in small editions, are smaller than the cost of making signatures for the flat-bed press; the Mimeoform Process, therefore, is the cheapest method of presenting textual matter in print-face type, in editions up to five hundred.

Publishing by Mimeoform Process demands spacing of **six lines to the inch regardless of type size** (8, 10, and 12 point). Illustrations, even half tones, can be combined with text at no greater cost than for printing, if curved plates are provided. The most economical Mimeoform format is an 8-1/2" by 11" page, set in ten-point type.

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AN ECONOMICAL MIMEOFORM FORMAT
(Paper size 8–1/2 by 11 inches)

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AN ECONOMICAL MIMEOFORM FORMAT

(Paper size 6 x 9 inches)

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printing to the purpose of book production has been made by the Mimeoform Service under the direction of Dr. Ernest Kletsch, who styles his process the mimeoform process.[6] He uses a Lanston Monotype for setting the type, which is cast in a low type mold, 8-, 10-, or 12-point. A special caster (the only part of his equipment that may not be found in almost any establishment supplying multigraph shops with composition) automatically delivers the line of short type, properly spaced and justified, to the channels of the multigraph drum. When the drum is filled, the caster automatically stops. It takes only half a minute to fit the drum to the multigraph machine, and the printing can begin. Proofreading is done immediately, and corrections are quickly made from the case of type.

There are certain defects in the appearance of the finished mimeoform product. Within the range of type sizes from 6-point to 12-point, all the type faces available for monotype composition are available for multigraph composition, and pages are produced by the multigraph with all the features of print-face, such as justified lines, italics, bold-face, etc. But the appearance of the printed page sometimes displays certain imperfections. As the type is transferred to the channels of the drum, it occasionally slips up or down or slightly awry. This results not only in a poor alignment of type, but in some cases in an indistinct impression. In general, the product of the mimeoform does not approach the highest quality of the flat-bed cylinder press.

A limitation in format is also to be noticed. The space between the channels on the multigraph drum, into which the short type is transferred by the caster, is fixed, permitting not more than six lines to the inch, regardless of size of type. Thus all four type sizes available (6-, 8-, 10-, and 12-point) are cast on a 12-point body (note Figure VI, set in 12-point and 8-point type). This means that lines of 10-point type, the most commonly used for book composition, would be leaded two points; 8-point type, four points; and 6-point type, used for footnotes, six points. For spacing between paragraphs, a channel of the drum would be left empty. In 10-point composition the loss in compactness over ordinary composition leaded one point is about 30%, and this percentage increases as the size of the type decreases. The waste of space is particularly great in footnote work. The effect of this wastage of paper area can be neutralized by using the full surface of the drum and printing upon a large page, 8 1/2" x 11". Running costs are the same for this large page as for a smaller one, and indeed, in the writer's opinion, the best possible format for mimeoform work is an 8 1/2" x 11" page set in 10-point type in two columns (Figure VII).

One further limitation of the multigraph as a book-printing device must be mentioned: it is quite unsuited to any publishing in which illustrative material is to be put on the same page with textual matter. Although it is possible to incorporate line cuts or coarse screen half tones in a page of matter produced on the multigraph by purchasing small curved electrotypes of the illustrative material, the cost is such that it is more economical to use some other process--e.g., photo-offset --for highly illustrated text. On the other hand, if illustrations are on separate pages, the multigraph is well suited to their use, because they do not have to be interleaved in signatures but can be gathered for binding like any other pages.

The mimeoform process of multigraph printing is useful for the production of scholarly books when the edition is in the region of 100 to 500. Considerable savings over ordinary printing are here effected because composition costs are reduced, in some measure, by wage-scale factors and by the very difficulty of making author's corrections which tends to enforce upon authors practices that would be equally effective in reducing printing costs.[7]

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[6] Other names for similar multigraph services are Mimeo-Gravure and Mimeo-Photo.

[7] The multigraph interferes somewhat with the working habit of scholars who expect to receive proofs of a 300-page book, leave them on the desk for a week, and correct them when they "get to it." The Mimeoform Service does not at present have the equipment for holding so many pages in type pending submission of the proof to and by the author, and the office routine is based on the assumption that the proofreader alone, not the author, will be responsible for final correction. This situation could be changed by an extension of equipment and a change of routine. The effect of the change would be a slight increase in costs.

Area costs are held down because make-up is eliminated, being combined with typesetting, and because there is no make-ready, and it is in area costs that the principal savings occur. Running costs are higher in proportion than printing press running costs because each page is run separately; for that reason, printing will always catch up with and pass mimeoform, if the edition is large enough, but in the region of 100 to 500, running costs are so small a part of the total costs that the economy of the flat-bed press in printing sixteen pages at a time is of small importance.

The following figures show the comparative prices of mimeoform and flat-bed cylinder publication, and show the mimeoform process lowest in cost as a means of presenting straight textual matter in print-face type in small editions. The advantage of the mimeoform fades out when the size of the edition passes the 600 mark. The costs per page as here quoted in 1934 are within the range of those that Bean found normal in 1927--from $2.25 to $4.00.

TABLE IV

ESTIMATE FOR COMPOSING AND PRINTING BY MIMEOFORM AND STRAIGHT PRINTING A BOOK OF 50,000 WORDS, 6" x 9" TRIM SIZE, 128 PAGES
(Not an economy format for either process)

PROCESS	EDITION SIZE AND ESTIMATE						
	100	150	200	300	400	500	600
Mimeoform	$160.00	$160.00	$160.00	$179.20	$198.40	$217.60	$236.80
Printing (a composite of five estimates)	$286.68	$289.00	$290.00	$294.66	$298.17	$301.87	$305.36

TABLE V

ESTIMATE FOR COMPOSING AND PRINTING A BOOK OF 50,000 WORDS IN VARIOUS FORMATS

PROCESS	EDITION SIZE AND ESTIMATE						
	100	150	200	300	400	500	600
Mimeoform (8 1/2" x 11" trim size in 10-pt., 2 cols.)	$143.00	$143.00	$143.00	$160.00	$177.00	$194.00	$211.00
Printing (6 3/4" x 9 1/2" trim size, 11-pt. on 12 Granjon, 2 cols.--newsprint format)	$280.00	$285.00	$290.00	$299.00	$307.00	$315.00	$323.00
Printing (8 1/2" x 11" trim size, 7-pt. solid, 3 cols.--economy format)	$300.00	$308.50	$317.00	$334.00	$350.00	$365.00	$380.00

Note: The quotation on the "economy format" from one firm turned out to be higher than the average of five quotations on a less economical format. If the specifications had been sent out for quotations to the five firms who estimated for the upper table, the price would be lower. The point of this table is to compare estimates on a newsprint format with estimates on a good sound book format.

8

9

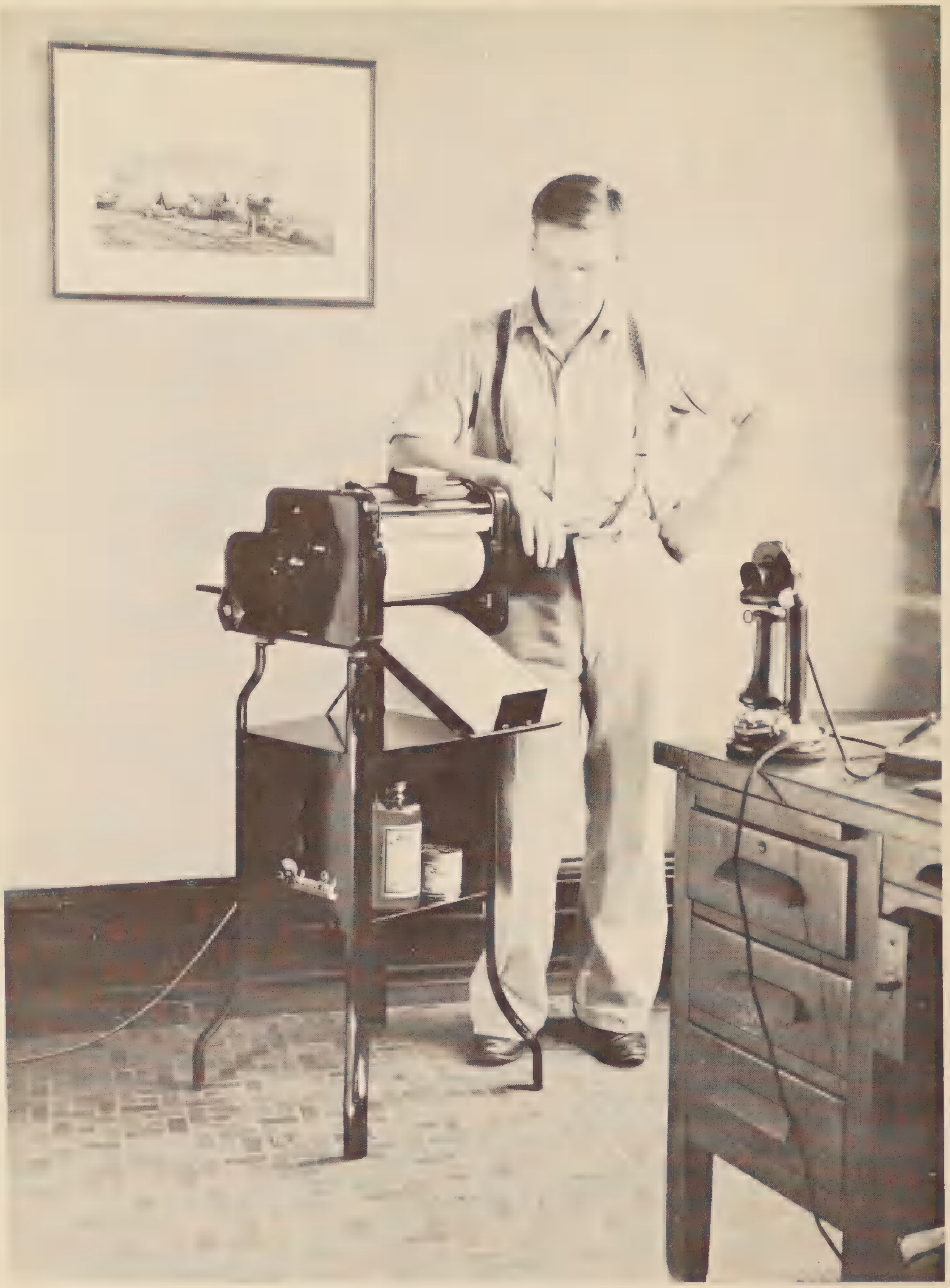

FIGURE X

The Rotaprint

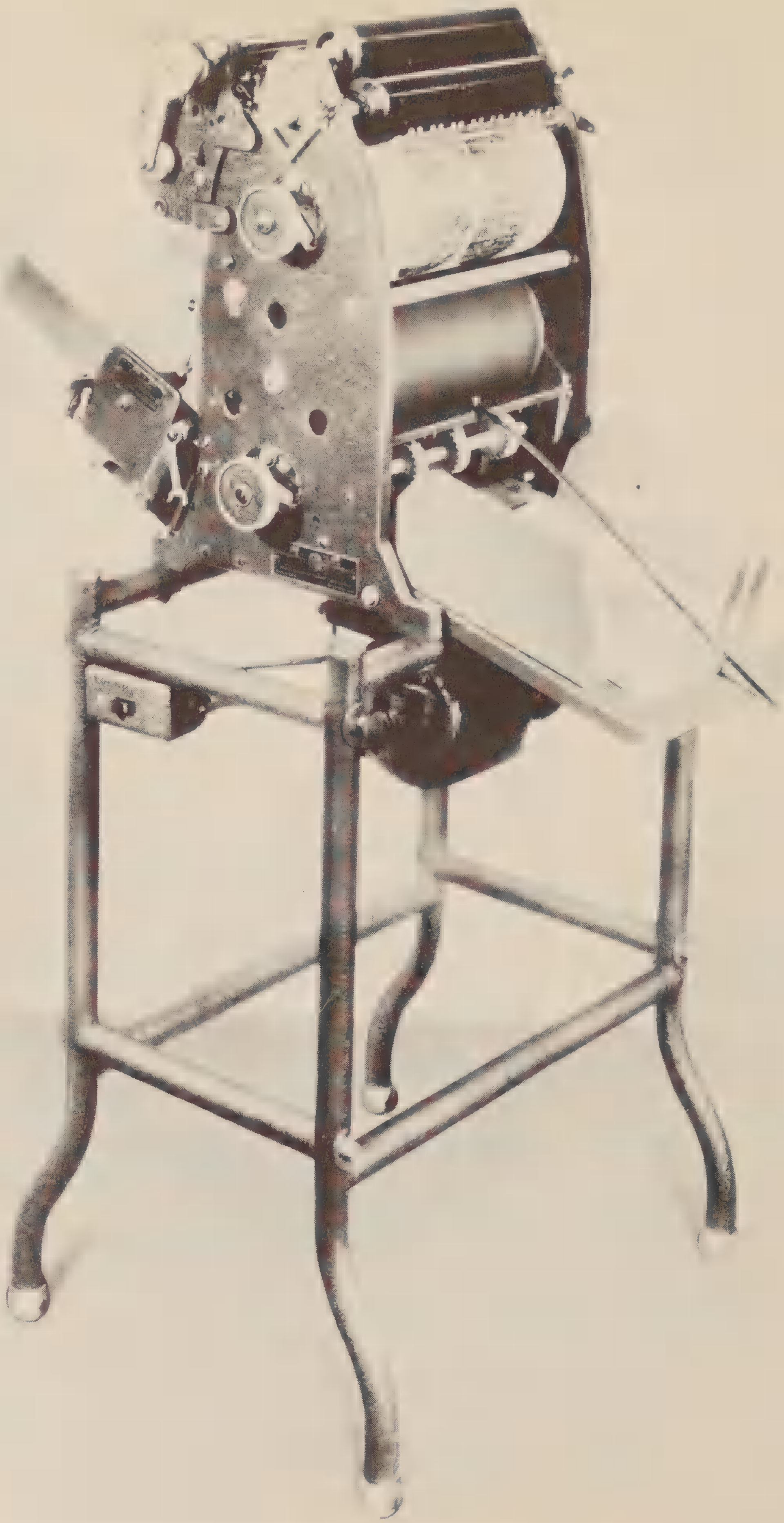

FIGURE XI

Model 200 Multilith

Alternatives to Printing

This is the cost picture that printing presents to the scholar. If the problems of scholarly publishing are not met at this cost level, the alternative to be studied is the use of typescript reproduced by photo-offset, the mimeograph or hectograph, or by some photographic process. Of these, photo-offset is the most frequently applied to book production. The first use of these processes is found in bringing back into print materials already available in printed form; but they can also be used for publishing new matter from typescript. However, these processes can be most clearly analyzed as devices for reprinting, and they will therefore be described in that connection.

Reprinting: the Photo-offset Process

The process known as photolithography, photo-offset, lithoprinting, offset printing, planograph printing, and a number of trade or firm names, has developed in the last thirty years from the combined application of the principles of lithography and photography, together with a new type of printing press.

Lithography was developed by applying the principle that grease repels water, but attracts a greasy ink. The process was discovered in 1796 by Alois Senefelder of Munich, who used the limestone of Solenhofen, Bavaria, which was especially good for absorbing water and taking grease. A stone surface was covered with the greasy marks of a lithographic pencil, then moistened and then inked. The ink would adhere to the pencil marks, avoid the moistened spaces, and transfer to paper as a lithographic print. This direct method from stone to paper necessitated the image to be drawn or imposed on the stone in reverse.

The same principle is applied in the photo-offset process, which is fundamentally lithographic in character. A photographic image is transferred, via a negative, to a metal plate covered with a light-sensitive emulsion (albumen with ammonium bichromate). An exposure to an arc light hardens the portions of the emulsion under the transparent parts of the negative so that they remain on the plate after development as an image of the copy to be reproduced. Thus the process is photographic. A sample sheet of the negative (Figure VIII) and a sample piece of a used metal sheet from the multilith (Figure IX) are bound herewith.

The emulsion image is of such a character that it is receptive to greasy ink. The plate, therefore, may be placed upon a press which moistens it (the moisture adheres to the parts of the plate not carrying the hardened emulsion) and inks it (the greasy ink avoids the moistened surfaces of the plate, but sticks to the emulsion image). The printing surface is flat; it has no raised surfaces like type faces, no sunken intaglios; hence the name "planographic."

The third element of the process is the offset press. The first practical offset press, upon which flat-surface metal plates could be used, was developed in 1906. A few years earlier Ira W. Rubel, a lithographer of Nutley, New Jersey, conceived the idea of developing an offset press while watching a feeder operate a cylinder press. When the feeder missed a sheet, as sometimes happens, there was made on the tympan sheet an impression which offset on the back of the next sheet and produced a better print than the one Rubel was getting by direct impression. He thereupon developed an offset press in which a reversed image was printed by the flat-surfaced plate on a rubber blanket, from which the wet impression was offset on the paper sheet. It is this last feature which has given the whole process its name of "offset printing."[8]

For scholarly publication, two small offset presses, the "rotaprint" and the multilith (Figures X and XI), which are used by business offices doing small runs of advertising matter or publishing a house organ, deserve special attention. When soliciting business, the users of the large offset presses regard these smaller units as little better than office appliances; the users of the small presses challenge this judgment. But in the presence of the NRA the large offset press people tried to make rotaprint and multilith come into the Graphic Arts Code, while they held out on the claim of being merely office appliances. Examples of their work will enable the reader to judge of their relative quality (see Figures XXV and XXVI in Chapter V). This volume is planographed with a Harris press (Figure XII), which has also been used in reproducing pictures in the chapter on illustrations.

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[8] The two elements of the process--the photographic preparation of a metal printing surface and the use of a rubber blanket to "offset" the impression--are not necessarily and indissolubly connected. There is one press, the Schwarze Presse or Coxhead Press, which brings the metal printing surface directly in contact with the paper. It is planographic in the sense that the printing surface is a plane, photographic in that the surface is prepared by photographic means, but it is not an offset process. The Schwarze or Coxhead process also differs from most planographic processes in that no negative is used in transferring an image to the metal. A drawing is laid directly on the sensitized metal and the image burned with an arc light. This process has its place, particularly in the multiplying of architects' drawings, but no extended analysis of it is required here.

Photo-Offset: Composition Costs

The composition of the text from which the photographic negative is produced is not actually part of the photo-offset process: in preparing a new book by photo-offset, either ordinary raised type composition or typewriting would be used, and the factors affecting these costs are elsewhere discussed. If ordinary linotype composition were resorted to with this process, no saving would be possible unless a considerable number of illustrations appeared; the production of typescript books by photo-offset will be examined in Chapter V.

In the present discussion photo-offset is being considered as a reprinting device, and in the case of a reprint of a book by this process, there is actually no composition whatever, the old book serving as master copy for the photographic part of the process.

Photo-Offset: Area Costs

In the photo-offset process cost behavior is controlled by the fact that first costs in the shop are essentially area costs. It is to the area costs, that is, to the preparation of the photographic negative and to the making of the metal plates, that chief attention must be devoted.

(a) The Photographic Negative

In the preparation of the photographic negative, various kinds of materials can be used. The photo-offset process was originally developed with wet-plate photography. This technique came to the photo-offset shop from the photoengraver. The photoengraver would coat a sheet of glass with albumen, collodion, and nitrate of silver in the order named, thus making a "wet plate." This wet plate would go into the camera and be developed and fixed as a photographic negative. It would then have its surface strengthened by applications of a liquid rubber solution and collodion. The result would be a "sandwich" of the photographic silver image between two sheets of collodion adhering to the glass plate. Then the photoengraver would soak off the sandwich with a bath of acetic acid and use it as a negative in preparing the metal sheet printing surface. More recently it has become the practice to use film rather than wet plate at this stage of the process, and now paper negative is taking the place of film for some kinds of work. The cost relationships of these three photographic media are approximately:

Paper negative	1
Film negative	3
Wet plate	6

When the material to be copied is of maximum legibility, with ample contrast between its black and white, the paper negative (Photostat N-26, Kodalith, Contrasto Polygraphic Company's product or Haloid Company's Litholoid) is wholly satisfactory. According to an estimate made for the Joint Committee, the paper negatives required in preparing metal sheets for a book of 128 pages, 6" x 9", would cost $5.12. If film were used, the cost of the films would be $17.92. Thus a variation of $12.80, or approximately 10% of a job priced at about $125.00 (exclusive of binding and paper costs) is controlled by the choice of film or paper negatives. On the other hand, when the copy is poor the photo-offset printer may be forced to use a wet plate negative.[9]

It sometimes happens that there will be no way of bringing the original copy of the book to be reproduced to the photo-offset printer. In such a case, a skilled photostat operator or commercial photographer, acting under instructions

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[9] The Typary and Typon Company, 1-4 Red Lion Passage, Fleet Street, London, England, manufactures a

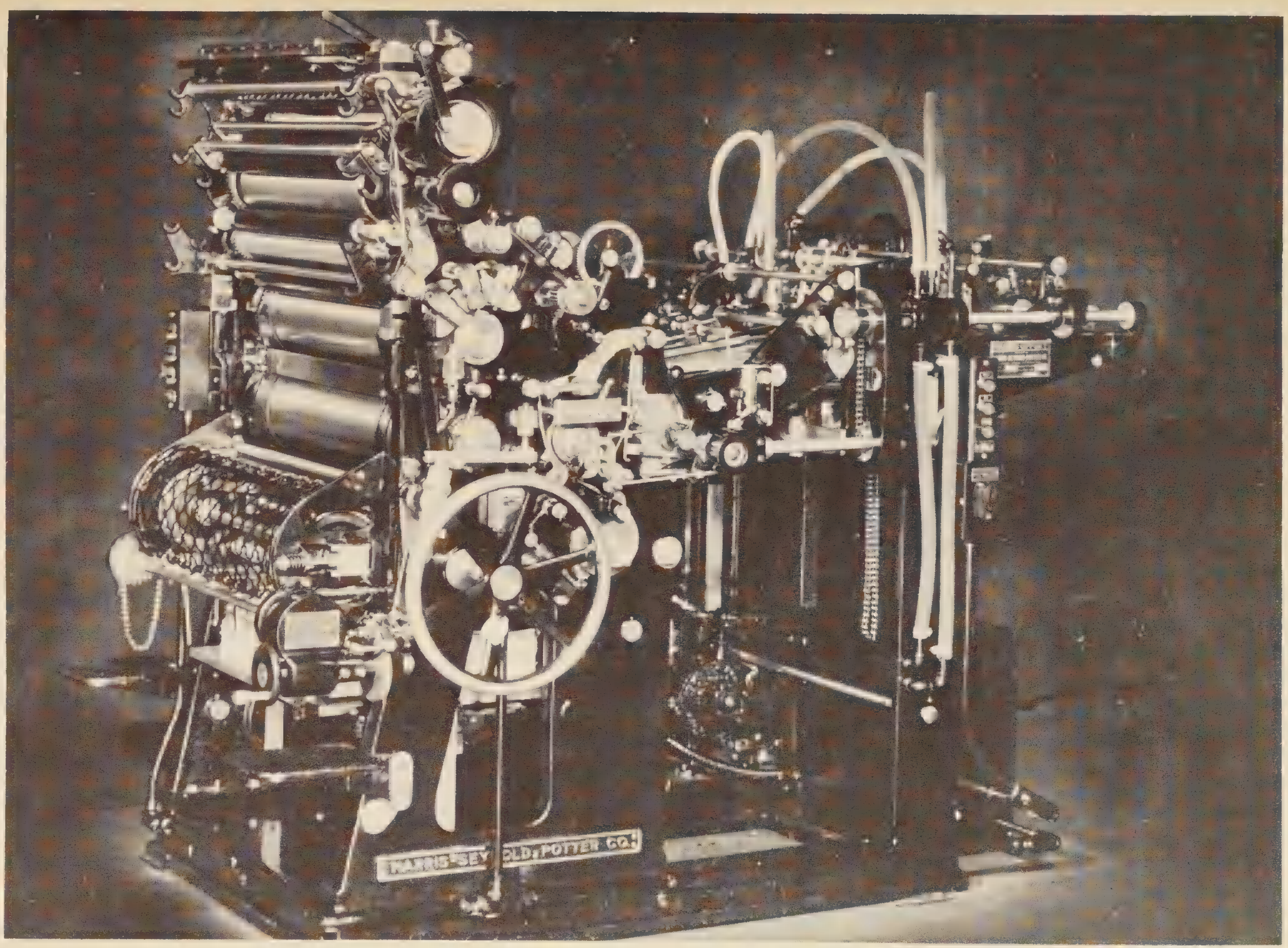
HARRIS-SEY OLD, POTTER CO.

FIGURE XII

Harris Press

given him for the purpose, can prepare the paper negatives. The situation may bring about a separation of the photographic costs from the strictly photo-offset costs. The trade does not usually work on this basis, but figures received from several sources indicate that a discount of 18% to 30% can be given if satisfactory paper negatives are provided to the photolithographer.[10] Another basis for calculating this cost is found in the difference between the original and reprint quotations when the photolithographer has preserved the negatives for the book, but not the metal sheets. This discount when given runs near to 15%.

(b) The Preparation of the Metal Plate

However, in computing area costs, the preparation of the metal plate is a more important factor than the making of the photographic negatives. The price per area of photo-offset printing surface has been calculated by Fred W. Hoch, author of the Standard Book of Estimating for Printers, and published in the American Printer for June, 1932 (p. 55), as follows. According to information recently received, these prices hold today. From these figures it appears that the price of photo-offset printing surface should be somewhere between $2.14 and $2.41 per 100 square inches. These figures agree roughly with those obtained from certain firms in 1933 and with quotations obtained in 1931.

(c) Full Utilization of Metal Plate Surface

Since the printing surface of the metal plates constitutes the most important factor in the determination of area costs, photo-offset work pages should be planned to use all of the surface of the sheets.

TABLE VI

PRICES ON PHOTO-OFFSET PRINTING SURFACE

	First 100 Copies	Per Additional 100's
8 1/2" x 11"	$ 2.00	$0.30
8 1/2" x 14"	2.75	0.40
9 1/2" x 12"	2.75	0.40
11" x 17"	4.00	0.60
14" x 17"	5.50	0.80
12" x 19"	5.50	0.80
17" x 22"	8.00	1.00
17" x 28"	11.00	1.40
19" x 24"	11.00	1.40
22" x 34"	16.00	2.40

(Footnote continued) "stripping paper." It resembles Kodalith paper except that the thin emulsion can be stripped dry off the paper base and transferred to the metal for the burning-in process. The emulsion stripped from the stripping paper is so much thinner than film or Kodalith paper that it is said to make a clearer image in the burning-in process and is therefore comparable to the wet plate in fineness. This paper is available in Germany at the firms of von Bayer in Leverkusen, Koln; the Mimosa-A.G., Dresden, Schandauerstrasse; the Baltische Papier-fabrik, Berlin, N. W. 7, Dorotheenstrasse 38.

The typon paper can also be used for making negatives for photo-offset work without photographic apparatus, as in reflection copying; the paper is laid on top of the original to be copied, exposed 10-20 seconds, developed by means of a special developer, and fixed, as usual. After drying, the emulsion is stripped from a stripping paper. Through this process the cost of the negatives is considerably reduced. Many books such as lexicons, law books, etc., are printed by this method.

Photographic apparatus is being manufactured by Hoh un Hahne of Leipzig, Germany, which will produce negatives of book pages for photo-offset work at a great speed: it is apparatus with self-acting bellows or dark slide, automatic shutters for exposure, and devices for the proper pagination and placing of the book.

[10] Figured on basis of quotations given for producing a book of 128 pages, 6" x 9", in an edition of fifty, exclusive of paper and binding costs.

This raises the question of the relation of page, plate, and press sizes.

There are on the market some eighty different sizes of offset presses, using metal sheets of eighty different dimensions. Yet such is the force and pressure of standardization in the trade that most operators will aver that all these variant sizes are best adapted to the two standard page sizes, 6" x 9", and 5 1/2" x 8 1/2" (and its double, 8 1/2" x 11"). These are, in fact, the page sizes that will divide most evenly into the standard cuts of book paper and bond paper. They are convenient, but they may turn out to be wasteful.

For example, the rotaprint metal sheet, now officially known as Rotaplate, measures 11" x 17". It will take perfectly two pages of normal typewriter size paper, 8 1/2" x 11". A working margin of 1/2" may be needed. But suppose a book of 6" x 9" should be run on this press. No less than 42% of the available printing surface would be wasted. In printing a book of 128 pages, 6" x 9", on this machine, sixty-four plates would be required, for no more than two pages could go on each plate. At $1.50 a plate, the cost would be $96.00, and of this about 42%, or $40.00, is wasted. Whoever would print 6" x 9" pages should find a printer with another size of press. In bringing back into print some old book that happens to be printed in large-size type, it might be advisable to reduce the size to one that will fit evenly, or with minimum wastage, on the metal sheet of the press that will be used on the job.

(d) Area Costs and Legibility

The principle which permits this economy has wide application. Since the printing surface for the photo-offset process is prepared photographically, the material to be reproduced can be enlarged or reduced to any degree desired. The purchaser buys the use of a certain number of square inches of printing surface; it is almost immaterial to the printer what is contained within these dimensions. This opens the publisher to an interesting temptation. He can enormously reduce the cost of reproducing any given text by reducing the size of the print. If he cuts the print in half, he increases fourfold the amount of printed matter on his area of metal. Thus, it has been proposed that the New York Times be issued in a half-size edition for permanent preservation.

The ease with which photo-offset printers can enlarge or reduce the size of the matter they copy, taken in connection with the controlling position of area costs, gives to the problem of legibility a special importance. The size of the type-face can be fixed at any point, from microscopic to above normal, and while the diameter is shrinking in arithmetical series--1,2,3,4, --the cost of producing the copies is shrinking in geometrical series--2,4,8,16. This situation creates a temptation to pull the size of the print down to the lowest point of legibility. There would seem to be several thresholds: first, the limiting size of the type that can be read without special strain or attention (according to Vernon, it is 6-point type); below this there is perhaps the smallest type that can be read without the use of a reading glass; and below that, the lower limit of reading glass efficiency.[11] Efforts have been made to use photo-offset at all these levels. The Hispanic Society has reprinted a rare Spanish dictionary in a reduction to one-sixth of its original size.[12] The experiment of the New York Times with a miniature edition reduced 50% from 7-point type has been mentioned. These experiments together with others are appraised in Chapter X in connection with various optical devices for reading. For the present, it is necessary to collect such information as may be available on the effect of photo-offset reductions of type upon legibility with the naked eye.

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11. See table in Chapter X, page 116.

12. "....the photographs used in reproducing the Covarrubias. Tesoro de la lengua castellana. o espanola we beg to report that the photographs used in reproducing the Covarrubias were made at the Hispanic Society. Each of the 1382 pages was photographed separately on a 5" x 7" panchromatic film, using an apochromatic lens. Glossy prints of these negatives were mounted on sheets of cardboard, nine prints to a sheet, and this material was sent to the Rudge Company for reproduction by the offset process. The microphotographic reproduction contained 154 pages. The reduction is six diameters to one." From letter of the Hispanic Society of America to Robert Binkley, February 18, 1932.

Relation between amounts of planographic reductions of newspaper print and loss in legibility

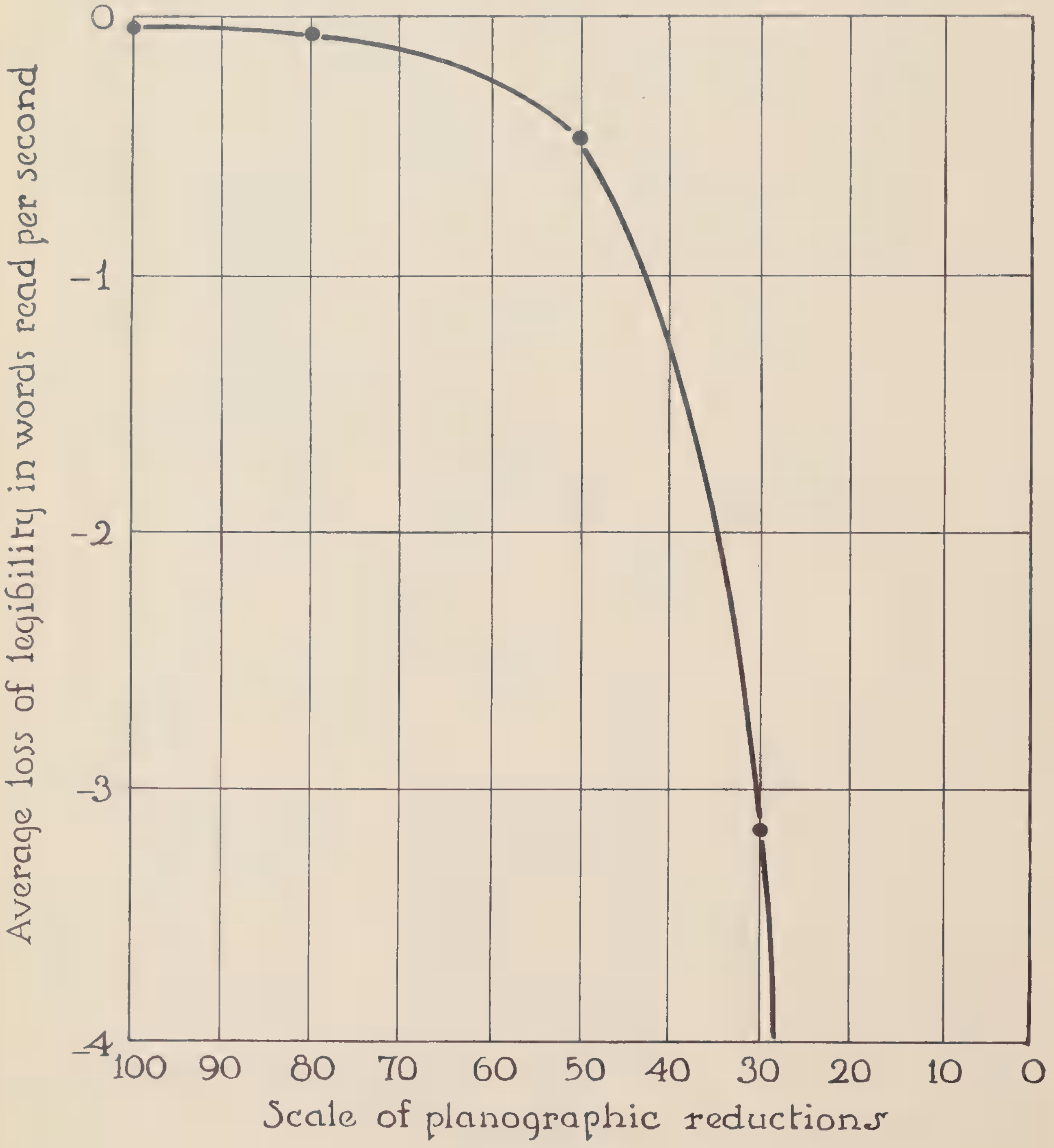

FIGURE XIII

The Joint Committee on Materials for Research secured the help of Professors Donald G. Paterson and Miles A. Tinker of the University of Minnesota in examining this problem. By a speed-of-reading test these scholars studied the legibility of newsprint of normal size (7-point) and newsprint reduced to 80%, 50% and 30% of normal size. The result of their work is a curve of diminishing legibility, as shown in Figure XIII.

To summarize: the relationships of legibility, type size, and area cost in photo-offset are such that costs of multiplying materials by this method must always be reckoned to include the type size and legibility factor. Just as the scholar with a new book to be set up in type for the printer will find costs depending on the number of words in the book rather than the size of the letters, so the scholar with an old book to be copied by photo-offset will find the costs depending on the size of the letters rather than the number of words.

Photo-Offset: Reprint Economy

An important cost element that must also be taken into account in evaluating the photo-offset process is that of reprint economy. The idea of "reprint economy" is one of basic importance in all publishing accountancy. It deserves, therefore, a close analysis. It has been shown that publishing costs are of two kinds: first cost and running cost, and that the first cost is a composite of two elements, composition cost and area cost. If a book can be made to pay its way in an edition of 2000, a reprint of the book, manufactured by the same process, could also be expected to pay its way provided 2000 new purchasers should appear after the exhaustion of the first edition. The number of prospective readers that can make a first edition pay can always make a second edition pay. But under certain conditions, the number of readers required to make a second edition pay need not be as large as that required to make the first edition pay. This result will follow whenever some of the work that has been paid for, as the "first cost" of the first edition can be held over and used again without additional cost in a second edition. The revolutionary importance of this element in the cost structure of text reproduction is realized most completely in microcopying, but the element is also present in relief printing and in photo-offset work.

The printer from raised type can hold his type or change his form into an electrotype by printing it in wax and depositing electrolytic copper in the wax matrix. He can then preserve the electrotypes and make a second printing without incurring any composition costs. But electrotypes and stereotypes are almost out of the question except for large editions. The electrotype for a 6" x 9" page, in a book of 128 straight-type pages, will cost approximately $1.50 a page unmounted, $2.00 a page mounted. The corresponding photo-offset device is to preserve the metal sheets, protected with a coating of gum and ready for a second run.

Some firms do not save the metal sheets, but save rather the photographic negatives from which they were prepared. The policies of photo-offset companies differ in the matter of passing on to the consumer the reprint economies made possible by saving the metal sheet or negative. Some policies and economies are here described for purposes of illustration:

Edwards Brothers, Ann Arbor. Preserves metal sheets free of charge. If cost of first run is $1.50 for first 100 copies, cost of second run will be $.83, a difference of almost 50%.

National Process Company, 75 Varick Street, New York. Saves the metal sheet, charging $1.50 for cost of storing. This is usually a sheet covering sixteen pages, so that the cost is about $.095 a page. If the cost of the first run is $1.50 per page for 100 prints, and sheets are saved, cost of second run, including charge for storage, is $.80 per page for 150 prints, a difference of 42%.

Chicago Planograph Corporation, 517 South Jefferson Street, Chicago. Retains all negatives, and, if customer desires, plates as well. "Certain percentage" of reduction given on reruns.

The Copifyer Corporation of Ohio, 1111 Power Avenue, Cleveland. Keeps plates and negatives until the customer releases them. No charge is made for negatives, but a charge of $1.00 per plate is made after three months.

The Tudor Press, Inc., 251 Causeway Street, Boston. Holds plates and negatives for one year, and after one year, if ordered. Reprints made at approximately $.50 per page less. If cost of first run is $125.00 (exclusive of binding and paper costs) and sheets are saved, cost of second run is $61.00, a difference of 51 1/2%.

William B. Burford Printing Company, 38 South Meridian Street, Indianapolis. Saves both plates and negatives for six months without storage charge, allowing 50% reduction for reprints.

R. R. Donnelley and Sons Company, 350 East 22 Street, Chicago. Saves negatives without charge indefinitely. Plates can be saved on request for a short period for reruns. If plates cannot be used after this period, a charge is made for making new ones.

The importance of reprint economy is twofold. It can lower the cost of certain specific printings of books, and it can affect policy in regard to overprints. If a second printing is cheaply available, it is not necessary to risk large first printings that may remain unsold.

Photo-Offset: the Outlook for the Future

The development of the photo-offset apparatus as an additional shop equipment for letterpress printers has already had an important influence on scholarship through the production of cheap reprints. In at least one instance--the making of the new Early Modern English and Middle English Dictionaries under the sponsorship of the American Council of Learned Societies--it has resulted in an extraordinary saving of scholarly labor. The editors of these new dictionaries have selected the writings of this period to be used in the dictionaries. The manuscripts and early prints have been reproduced by photo-offset and set before the scholars in loose-leaf form--about 200 impressions of each page. The scholar takes one page and marks in it all the words to be indexed. A typist then takes one loose-leaf for each word marked by the scholar, types the marked work at the top of the leaf and files it alphabetically. This method would seem to reduce the making of concordances to an almost wholly mechanical procedure.

What kinds of technological developments of photolithography would be likely to have an important impact on scholarship? Nothing that affects the cost levels of the very long runs will have any significance.[13] But if the time should come when the apparatus would be so far simplified and the process so far cheapened that it could become a kind of multiple photostat, a part of the equipment of any large library and serviced by ordinary library labor, turning out extra copies of library rarities for sale or exchange with other libraries and sometimes multiplying overused library materials for teaching purposes, great results in the intellectual

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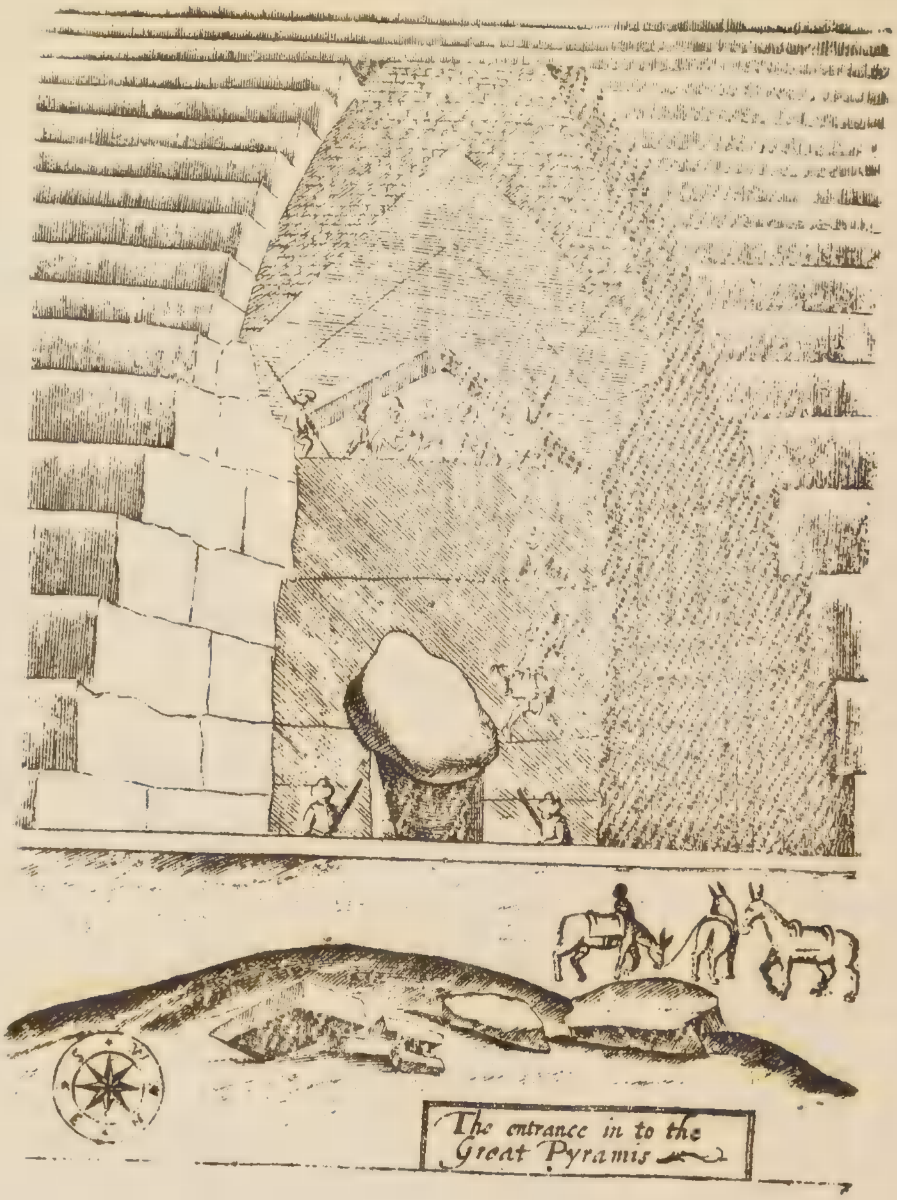
[13] Technological developments having their principal bearing on long-run work are the Uhertype apparatus, consisting of a photo-composing machine, by which letters are photographed on a film strip, and a make-up machine, which is a large reproducing camera; The Teletypesetter, which operates slug-casting machines automatically with perforated tape; the Typary, producing proof slips, photoprinted on paper, which may be used to make negatives from which positives are produced on offset metal plates; sometimes translucent paper is used in the machine to make proofs which can be used directly on the metal plates; the Typon, employed for photo-production with the Typary by camera or contact, in which a paper strip film is used instead of a dry or wet plate; Walton's typesetting machine, which writes directly on a metal sheet for offset printing; various other devices activated by the photoelectric cell. In offset printing, important experiments are being made in mercury processes, in which mercury is used instead of water as an ink-repelling medium; in developing formulae for producing deep-etched plates; in dry offset, when the plate is treated with an ink repellent, which does away with the moistening rollers of the offset press and controls both the temperature of the plate and the humidity of the air around the plate, thus providing and keeping constant the moisture needed throughout the run. Cf. Printing Progress, a report prepared by a special committee of the Printing Industries Division for the Engineering Week Meeting, June 25-July 1, 1933.



The entrance in to the Great Pyramis

to have done us a miſchief; and guarded the mouth whilſt we entred, for fear of the wild *Arabs*. To take the better footing, we put off our ſhoes, and moſt of our apparel; fore-told of the heat within not inferiour to a Stove. Our guide (a *Moor*:) went foremoſt: every one of us with our lights in our hands. A moſt dreadful paſſage, and no leſs cumberſom; not above a yard in breadth, and four feet in height, each ſtone containing that meaſure. So that always ſtooping, and ſometimes creeping, by reaſon of the rubbidge, we deſcended (not by ſtairs, but as down the ſteep of a hill) a hundred feet, where the place for a little circuit enlarged, and the fearful deſcend continued, which they ſay none ever durſt attempt any farther, ſave that a *Baſſa* of *Cairo*, curious to ſearch into the ſecrets thereof, cauſed divers condemned perſons to undertake the performance, well ſtored with lights, and other proviſion; and that ſome of them aſcended again well-nigh thirty miles off in the Deſarts. A Fable deviſed only to beget wonder. But others have written, that at the bottom there is a ſpacious Pit, eighty and ſix Cubits deep, filled at the over-flow by concealed Conduits: in the midſt a little Iſland, and on that a Tomb containing the body of *Cheops*, a King of *Egypt*, and the builder of this *Pyramis*: which with the truth hath a greater affinity. For ſince I have been told by one out of his own experience, that in the uppermoſt depth there is a large ſquare place, (though without water) into which he was led by another entry opening to the South, known but unto few (that now open, being ſhut by ſome order) and entred at this place where we feared to deſcend. A turning on the right hand leadeth into a little room: which by reaſon of the noyſom ſavour and uneaſie paſſage, we refuſed to enter. Clambering over the mouth of the aforeſaid dungeon, we aſcended as upon the bow of an arch, the way no larger than the former, about an hundred and twenty feet:

world would be likely to follow. How far is technology from that possibility? Certain new developments tending in this direction have come to the knowledge of the writer, but must for the time being be kept confidential.

The rotaprint was the first machine to offer itself as a piece of office equipment. The cost of a rotaprint installation is about $1000 (9" x 14" model, friction feed; suction feed, about $1575). The latest rotaprint model, R 50, is $660.00 complete. Compare this with the price of photostat equipment, which is $800. Then came the multilith, offering an installation for $630.00 (friction feed, in its standard size, 9 1/2" x 12 1/2" printing surface, 10" x 14" paper). There has been developed a combination mimeograph and offset press which will permit a changing over from the mimeograph stencil, inked from the inside, to a photo-offset metal plate, inked from the outside. There is some possibility that a system may be devised whereby a kind of photostat paper can be treated to become a printing surface. The operator would make a photostat copy of a page, treat the photostat negative, fasten it on a small press, and run off a number of copies. New developments are appearing every year. The major institutional changes in scholarship can be expected to begin with the development of a photo-offset process so simple that the printing surface is prepared at the area cost level of the photostat copy and the running costs of making copies stand at the cost level of the mimeograph.

Reprint Processes: Dermaprint

The dermaprint is at present the process that tends toward this desideratum. It is a photographic process tied to the mimeograph. It is not planographic nor does it use the offset principle, but it does the same kind of work that the cheaper offset presses do. The relative fineness of the products of these processes can be compared if the sample dermaprint page bound herewith (Figure XIV) is compared with the sample products of the multilith and rotaprint (Figures XXV and XXVI).

The page to be dermaprinted was selected because it was yellowed with age and contained a line cut. The standard charge of the A. B. Dick Company for an 8 1/2" x 11" dermaprint stencil is $3.50, which includes a small amount of retouching. If a considerable amount of retouching is necessary, there is a standard extra charge of $1.00 per hour. The cost of the materials needed to make this particular stencil was $.64, which included a film negative and a film positive. Had a paper negative and a paper positive been used, the materials cost would have been somewhat lower. One hour and forty-five minutes were needed for the preparation of the stencil.

While the A. B. Dick Company gave their very generous cooperation in the preparation of the dermaprint stencil reproduced here, they call attention to the fact that, in general, the dermaprint process at the present time is more to be used with direct contact prints than with the use of the camera. The reader may judge for himself, by comparing the dermaprint product shown here with the cost calculations given above, what place dermaprinting can have in the reproduction of research materials.

The dermaprint stencil resembles the ordinary mimeograph stencil in appearance. It is a fibrous sheet impregnated with a substance impervious to ink. But whereas the ordinary mimeograph stencil is impregnated with a material resembling wax, which can be mechanically abraded by the typewriter stroke until the ink will penetrate through the bruised parts, the dermaprint stencil is impregnated with some kind of gelatinlike substance which is subject to tanning or toughening in the presence of the chromate ion. Whereas ordinary gelatin will dissolve in water, a gelatin that has been tanned will resist water. This is the chemical principle upon which the dermaprint works.

The raw sheet, already covered with a gelatin, is sensitized with ammonium bichromate or, more commonly, potassium bichromate. Ultra-violet light on the potassium bichromate will release the chromate ions and tan the gelatin. It is only necessary, then, to subject to ultra-violet light those parts of the sheet that are to be kept ink-resistant. The dermaprint stencil must, therefore, be prepared by using a black-on-white or positive photograph, or, as in the production of the so-called "special stencil," from an original black-on-white drawing on very thin or transparent paper, tracing cloth, vellum, or celluloid. In this it differs from the ordinary photo-offset metal sheet, which is prepared as a printing surface by using a negative photograph. The light that reaches the surface of the offset metal sheet hardens upon the metal the substance that will accept ink; the light that reaches the surface of the dermaprint stencil hardens the substance that will resist ink and keep it from passing through. The positive photograph or the original drawing is pressed against the dermaprint sheet in a vacuum frame and exposed to an intense light. Then it is given a bath in warm water and dried. The warm water dissolves out that part of the gelatin which has been protected by black ink from the rays of the light, but leaves the other part intact. Thus a stencil has been prepared automatically.

The cost of equipment for the dermaprint comes into the same price range with the cost of multilith apparatus unless the photostat and the mimeograph have already been purchased.[14]

Estimated Cost of dermaprint equipment if mimeograph and photostat are available .... $23.00 - $350.00

Estimated cost of dermaprint equipment, including photographic and mimeograph apparatus $1275.00

The cost of printing surface for the dermaprint process as compared with rotaprint and multilith metal sheets is shown in Table VII below.

The supplementary photographic supplies needed for the dermaprint should normally cost more than those for photo-offset, except in the case of the direct method,

TABLE VII

COST OF PRINTING SURFACE FOR DERMAPRINT, ROTAPRINT, AND MULTILITH

Process	Size of Printing Surface	Price of 1 Stencil or Metal Sheet*	Price per 100 sq. in.	Price per 6" x 9" Page	Price per 8 1/2" x 11" Page
Rotaprint	8 3/8" x 11"	$.28	$.318	$.28	$.28
Rotaprint	8 3/8" x 13"	.28	.257	.14	.28
Dermaprint	7 1/4" x 10 1/4"	.13	.174	.13	.13
Dermaprint	7 1/4" x 14"	.15	.147	.075	.15
Multilith	9 1/2" x 12 1/2"	.35	.294	.175	.35
Rotaprint	11" x 16 1/2"	.48	.264	.24	.24
Multilith	11" x 17"	.50	.263	.25	.25

*Prices in quantities of 100.

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14. The photographic equipment needed for transferring matter to the stencil may cost from $20.00 to $1300, with many possible combinations in between. The $20.00 equipment, which may be used for the direct process only, does not include a vacuum frame; the same equipment, with a $60.00 Eastman pressure frame, costs $75.00, and with a vacuum frame, $150.00. This same equipment may be used to prepare the photographic stencils if the user purchases his film positives from a maker of offset plates. If a photostat and a special adapting holder are used, the equipment will cost about $260.00, figuring $85.00 for a holder, $155.00 for a vacuum frame, and about $20.00 for dark-room equipment; if the photostat prepares a film positive, the $23.00 equipment may be used, the total cost of the equipment being about $110.00. Mimeographs vary in price from $30.00 to $450.00.

because the dermaprint must have a positive copy, while photo-offset can use the negative. The photographer is through when he has made his negative for photo-offset, but if he is preparing for the dermaprint, he is only half through and must still make a positive from his negative.[15] The cost of making this positive copy can be kept down if it is made by the filmslide process (see Chapter VI). Ordinarily the dermaprint uses just twice as much photographic paper as photo-offset. Moreover, it is not quite certain that the dermaprint can be prepared with a paper negative; if it turns out that film negatives are required, the cost of photographic materials mounts even further above the level of the photographic requirements of photo-offset.

Whether the dermaprint allows genuine operating economies is still an open question. The A. B. Dick Company offers to prepare these stencils, but the prices are so high that the service has no place in competition with other methods of book production.

Customer installations make these prices less important. The A. B. Dick Company has decided definitely to sell the unsensitized stencils at $7.00 a package or $.145 each, in the legal size, as indicated in a recent letter to the Joint Committee. Dermaprinting, therefore, would seem to be a practical reproduction method for any institution possessing photographic equipment and a mimeograph.[16]

TABLE VIII

PRICES OF DERMAPRINT SERVICE

Original stencils	Letter size (8 1/2" x 11")	$3.50 each stencil	(Compare with $1.25 to $2.00 as the price of preparing printing surface and running 100 copies by photo-offset)
	Legal size (8 1/2" x 14")	4.00 each stencil	
Duplicate stencils	Letter size	1.75 each stencil	
	Legal size	2.00 each stencil	
Special stencils	Letter size	2.25 each stencil	
	Legal size	2.50 each stencil	

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15. A letter recently received indicates that a method has been devised whereby, without any further photographic process, the negative can be reversed into a positive.

16. Another interesting device that has been used to some extent in Europe but has no practical importance in America is the Opalograph. The Opalograph principle bears a faint resemblance to that of the mimeograph. A slab of porcelain-like composition receptive to ink has painted upon it a film that will resist ink. This film can be cut by ammonia fumes. An ink which gives forth ammonia fumes is used in preparing the master copy. The master copy is imposed on the porcelain slab, thus cutting the text in the film and reaching through to the porcelain slab. The slab is then inked and used for a printing surface on a press not unlike a small flat-bed cylinder press. There is a kind of special photographic film which can be prepared as a positive copy, impregnated with an ammonium substance and used to cut through to the ink-receptive stone. Thus the Opalograph might be used for the reproduction of photographed texts, but the costs are high, and the process has no place in America.

A process used in Germany to bring out-of-print books into print is the Manul or Beha process. This is a planographic process differing from the usual method only in the way in which negatives are made, before the image is burnt into the sensitized metal sheet. But in making these negatives, it is necessary to destroy two copies of the original book from which they are made. The process is one of the "direct copying" processes; that is to say, it dispenses with the use of the camera. Glass is covered with a light-sensitive emulsion. The page to be copied is laid on this glass, and light is reflected from beneath. Under the white parts of the paper, which reflect the light, the solution is rendered insoluble; under the dark parts it continues soluble. The substances used are probably a gelatin and a chromate, as in the dermaprint. The whole glass is covered with an organic coloring matter. The soluble parts are washed away, leaving the negative copy of the original as a

The following table is a summary comparison of the factors affecting book manufacturing costs by three processes--printing, mimeoform, and photo-offset.

TABLE IX

	PRINTING	MIMEOFORM	PHOTO-OFFSET
First Costs (composition)	Varies directly with number of words or ems, and only slightly affected by type face, leading, etc. Time and a half and double time are charged for footnotes, tabular matter, etc.	Varies directly with number of words or ems, and only slightly affected by type size, type face. Composition about 30% less compact than for ordinary printing. Cost reckoned on a page basis. All type sizes on a 12-point body.	No composition costs for reprinting. (The behavior of typescript composition costs will be analyzed in the next chapter.
First Costs (area)	Make-up varies directly with number of forms and complexity of work (e.g., footnotes, illustrations, tabular matter, etc.). Make-ready varies in the same way as make-up. Neither is affected by size of edition.	No make-up since type is automatically transferred to multigraph drum by monotype caster. No make-ready.	The step the equivalent of make-up in printing is the preparation of plates. The cost equals that of make-up and make-ready in printing of small editions. Practically no make-ready.
Running Costs	Varies directly with size of edition, number of forms, grade of paper, and type of binding.	Variations similar to those in printing. Since pages are printed separately, the binding costs rise above those of printed 16-page signatures.	Variations similar to those in printing. Binding costs rise slightly for small press.
Reprint Costs	Electrotype takes $1.50 a page. This cost makes new composition costs unnecessary. By storing type or making stereotypes and electrotypes, new composition costs are unnecessary.	None	Storage of metal sheets at $.00 to $.10 per page reduces cost by approximately 50%; storage of negative by about 15%.

(Footnote continued) kind of stencil upon the glass. This stencil is backed with thin paper, dried a little and peeled off. It is then a negative ready to be transferred to the metal sheet. The Manul process of the Ullman Company and the Beha process of Breitkopf and Hartel seem to be the same thing. The German firms offering to reproduce by this process indicate by their quotations that the saving is greater than is possible with straight photo-offset printing.

CHAPTER IV

THE TYPESCRIPT BOOK OR MEMORANDUM: THE TYPEWRITER AND TYPESCRIPT

The typewriter has been well established as the device by which all scholarly work is prepared for publication. Authors often use it when drafting their manuscripts. Typed copy is always submitted to the publisher by the author and to the linotyper by the publishers. The fact that the typewriting stage intervenes so many times in the preparation of reading matter for distribution raises a question as to whether typescript could be carried not only as far as the linotyper, but also as far as the reader. In other words, what is the case for the typescript book?

In terms of the number of words written or the number of words printed and read, typescript rivals newsprint as the standard conventional writing form of contemporary civilization. Everyone is familiar with the typescript letter. Business men use information sheets and confidential letter services that are really periodicals in mimeographed form; they are becoming increasingly accustomed to seeing catalogues and statistical studies produced in typescript by "near-print" methods. The Government frequently mimeographs its reports. But the use of typescript is not generally associated with the publication of the internal documentation of scholarship. This is true, not on account of any deficiency from the standpoint of legibility, but because the possibilities of reproducing typescript economically and attractively have not been fully explored by the scholarly world.

This is really surprising in view of the fact that nearly everyone knows in a general way the qualities of the typewriter and the extent to which it has affected office practice. The typewriter itself is so cheap and widely distributed, and the skill to use it is so easily acquired, that its operating costs are low. Bond paper, filing cabinets, folders, and loose-leaf notebooks have been standardized to sizes that conform to it. Office appliances, even the office offset press, are keyed to its 8 1/2" x 11" sheet. There is only one standard measurement that has never conformed to it--that is library shelving. Library shelving is spaced to care for pages 10" or less in height. Libraries receiving typescript books on full-size typewriter paper are put to the inconvenience of shelving them with oversize books. But elsewhere the typewriter has brought equipment and practice into line with its dimensions.

By what means may the typescript book be produced? It may be a first copy from under the typewriter ribbon, as so many of our theses are, or it may be a copy multiplied by hectograph, mimeograph, or photo-offset. The choice of any of these reproduction methods for the multiplying of typescript material depends upon the degree of legibility afforded by the technique selected and upon the costs involved, which may be analyzed, as in the case of the printed books, as first costs (composition and area costs) and running costs. Of the methods mentioned, photo-offset presents the most complex problems in cost levels and legibility on account of the possibility of photographically reducing the size of the typescript in making a photo-offset copy.

The four mechanical devices for multiplying typescript will be separately analyzed in the following chapter, but it is necessary in the first instance to understand the characteristics of the typewriter itself.

The Standard Typewriter

The standard typewriters are priced at about $110.00. The type is standardized in two sizes, known as pica and elite. The pica typewriter lays down ten letters to the inch, the elite, twelve. How do these typescript letters compare with the letters of relief printing? A peculiarity of typescript as compared with print-face is the equal width of the letters. The typescript "i" is just as broad as the "m". This equal width is a necessary consequence of the mechanical system by which the typewriter spaces letters. A number of designers have proposed or attempted a typescript face that will resemble print-face; the task of making such a typescript face is rendered difficult simply because of the equal spacing of the typewriter mechanism. A change of the spacing system that would give the "i" a narrow space and the "m" a broad one would greatly complicate the machine and make it more expensive.

A new spacing mechanism has recently appeared in Germany. One model is available in America, in the hands of Edwards Brothers. This paragraph has been typed with it. Note that there are three different letter widths - the narrow letters such as f and i, the middle-sized letters such as d and g, and the two broad letters, w and m. The typewriter letter levers are linked each with one of two spacing rods; the m and w are given additional width by the typist, who strikes the space bar whenever she uses these two letters.

The difference in spacing is easily seen when set in a column in groups of six.

iii	iii
fff	fff
ddd	ggg
aaa	bbb
mmm	mmm
www	www

This new spacing device opens a new field to the designers of typescript face.

Special types are available, such as micro-elite, laying down fourteen letters to the inch, or ultra micro-elite, laying down sixteen letters to the inch. Their interlinear spacing is usually six lines to the inch. A sample page done with micro-elite type is shown in Figure XXVIII.

The Equivalence of Type and Typescript

If the horizontal measurement of typescript were taken as the basis in assigning it a position in the point system of typography, the following table of equivalents would result:

Pica typescript would be equivalent to 14-pt. type.
Elite typescript would be equivalent to 12-pt. type.
Pica reduced to 80% of normal size to 10-pt. type.
Pica reduced to 70% of normal size to 9-pt. type.
Pica reduced to 60% of normal size to 8-pt. type.
Pica reduced to 50% of normal size to 7-pt. type.
Pica reduced to 40% of normal size to 6-pt. type.
Pica reduced to 30% of normal size to 5-pt. type.

If, on the other hand, the vertical measurement of typescript were taken, it would be obvious that

Pica typescript would be equivalent to 10-pt. type.
Elite typescript would be equivalent to 8-pt. type.
Pica reduced to 80% of normal size to 7-pt. type.
Pica reduced to 70% of normal size to 6-pt. type.

The relative importance of the horizontal and vertical measurements of type controlling legibility has not been determined; it is, therefore, difficult to work out an accurate table of equivalents between print-face and typescript sizes and reductions. Since groups of letters or words, instead of single letters, constitute a sensory unit, it is probable that the vertical measurement of type is a more important factor in its effect on the reading rate, and consequently upon legibility, than the horizontal measurement. If such is the case, it would follow that typescript, despite its horizontal spread, is but slightly more legible than print-face of the same vertical point size. Figure XV shows blocks of 11-, 9-, 7-, and 6-point print-face type and corresponding blocks of typescript reduced to approximately the same legibility. The reader may note how far legibility affects word content by comparing the samples. To judge how far legibility suffers when typescript is so reduced as to lay down the same word content as print-face type on an identical area, the reader is asked to examine Figure XXIX.

Exhibit to illustrate comparison of print face types of various sizes and styles with typescript of varying reductions, having approximately the same legibility.

11-POINT PRINT-FACE

This is a specimen of 11-point Modern No. 8, which is assumed to be the equivalent of Pica typescript.

This is a specimen of 11-point Bruce Old Style, which is assumed to be the equivalent of Pica typescript.

This is a specimen of 12-point Garamont, which is assumed to be the equivalent of Pica typescript.

9-POINT PRINT-FACE

This is a specimen of 9-point Modern No. 8, which is assumed to be the equivalent of Elite typescript.

This is a specimen of 9-point Bruce Old-Style, a beautiful book face.

This is a specimen of 10-point Garamont, a very economical book face.

7-POINT PRINT-FACE

This is a specimen of 7-point Modern No. 8, which is assumed to be the equivalent of Pica typescript reduced 30 per cent

This is a specimen of 7-point Bruce Old Style. This size of type is generally used for newsprint.

This is a specimen of 8-point Garamont.

6-POINT PRINT-FACE

This is a specimen of 6-point Modern No. 8, which is assumed to be the equivalent of Pica typescript reduced 50 per cent.

This is a specimen of 6-point Bruce Old Style. Occasionally this type size is used for footnotes.

This is a specimen of 6-point Garamont.

FULL SIZE PICA TYPE

This is a specimen of pica type photographed full size.

FULL SIZE ELITE TYPE

This is a specimen of elite type photographed full size.

PICA TYPE REDUCED

This is a specimen of pica type reduced 30%.

This is a specimen of micro-elite type photographed full size, which is assumed to be the equivalent of pica reduced 28% to 30%.

PICA TYPE REDUCED

This is a specimen of pica type reduced 50 per cent.

FIGURE XV

THE MOST REVOLUTIONARY INVENTION SINCE the ADVENT of PHOTOLITHOGRAPHY

Simple Paper Permits Alignment of Typewriting

Scholars have been slow to accept photolithography as a solution of the problem of scholarly publishing because of the unconventional format which is produced by typescript. Because of the equal spacing produced by the conventional typewriter, a compromise had to be made in the design of the letters so that wide and narrow letters would occupy the same space. The result was that a letter such as 'm' had to be condensed, and a narrow letter such as 'i' had to be extended.

The fallacy of attempting to put regular printing types on the ordinary equal space typewriter is illustrated in the following paragraphs. The copy in the first paragraph was set up by a printer in the usual manner, without any attempt at justification. It was then reset, as it would appear if the type used were attached to the conventional typewriter. The lower case 'w' was used as the standard of horizontal spacing.

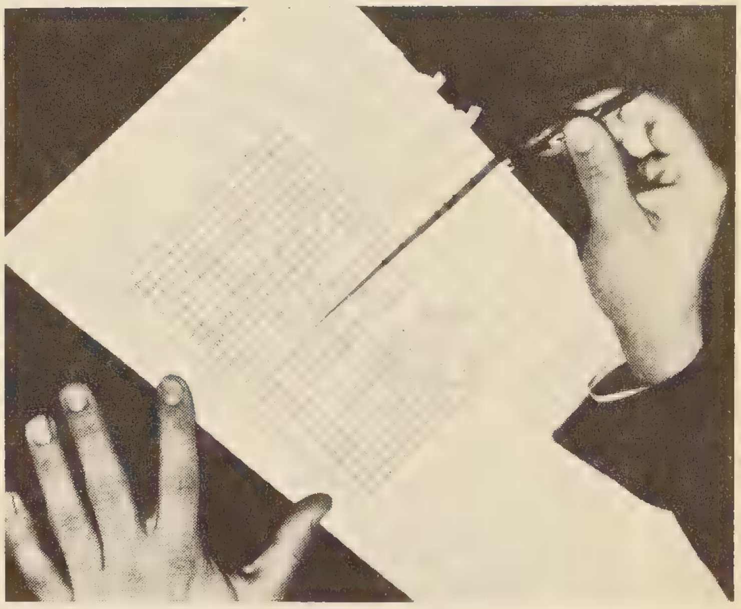
Authorities agree that William Caslon was influenced greatly in the design of his famous face by Dutch types which were used widely in England when he started his work. As D. B. Updike points out, while Caslon "modelled his letters on

wwwwwwwwwwwwwwwwwww

Authorities agree that William Caslon was influenced greatly in the design of his famous face by Dutch types which were used widely in England when he started his work. As D. B. Updike points out, while Caslon "modelled his letters on

The typewriter, moreover, does not produce justified lines, leaving an uneven right-hand margin so unusual in book printing that conventional taste will prevent the ready acceptance of typescript books. Fortunately it is now possible by the use of Vogeltype Aligning Paper to overcome one of the greatest objections to the use of typescript in scholarly work. The invention also permits the production of many sizes and styles of type without any change in the typewriter keyboard, as illustrated in the headlines on this page.

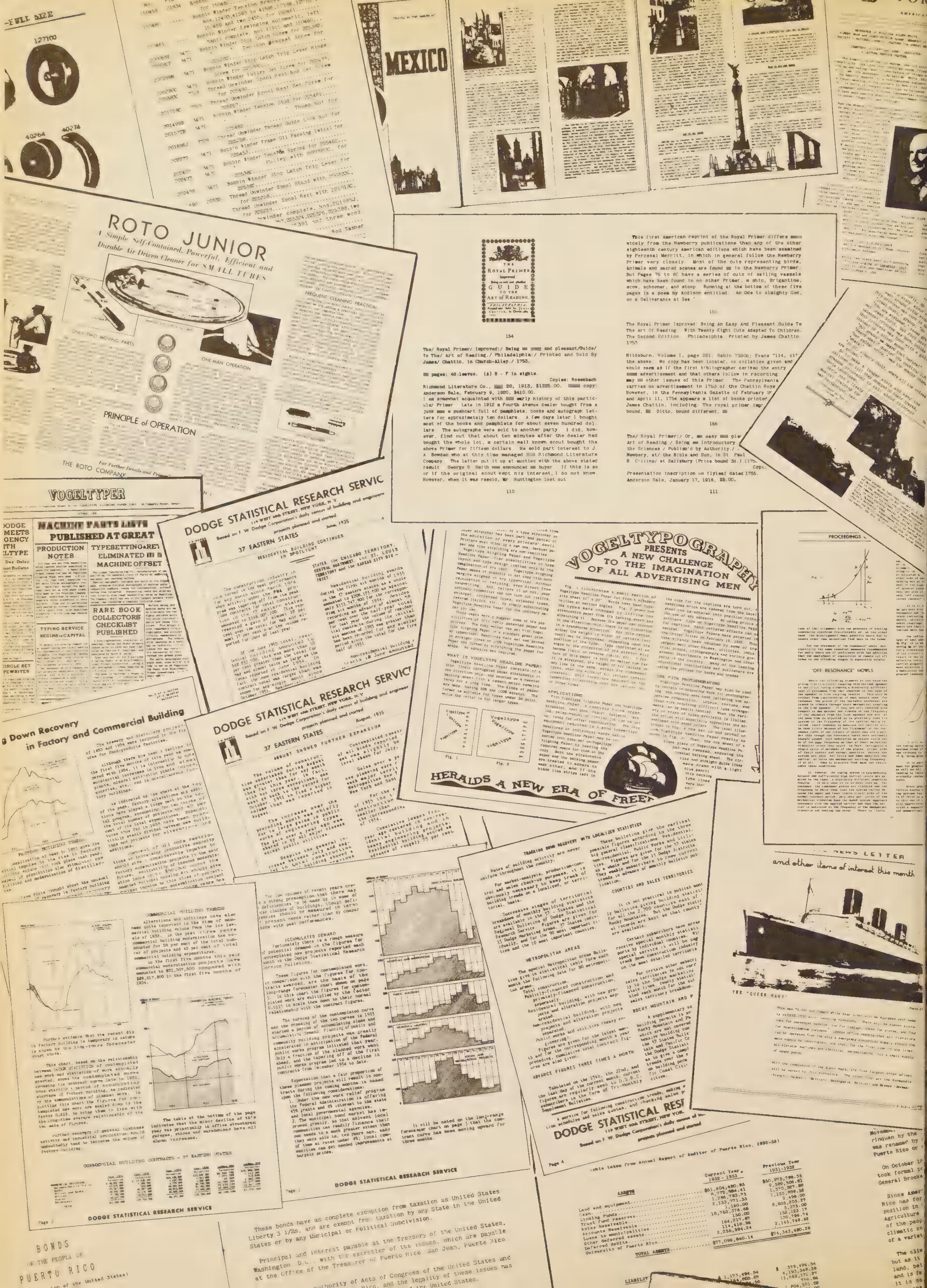
By producing a justified right-hand margin, typescript approaches printface in appearance. Doubtless through the development of a typewriter having automatic variable spacing, such as was built into the first typewriters invented, and type similar to ordinary printface, it will be possible for a scholar at his desk to produce a page format which can not be distinguished from real typeset matter. Thus modern technology, curiously, will bring man back to the conditions of the Middle Ages, when the scholar often was his own scribe.



A new stretchable paper permits typewritten copy to be aligned evenly on right-hand edges, allows lithographic production of books, briefs, etc., closely resembling printing, but cheaper

Scholars, moreover, will be able to illustrate their texts with photographs, graphs and tabular matter simply by making a pasteup combining illustrations and text. The photolithographic process allows great flexibility in preparing copy. Thus the above photograph of Vogeltype Aligning Paper was reproduced on a plate for the offset press by simply pasting a clipping from a magazine into its position in the text.

The greatly reduced reproductions on the reverse side of this page illustrate some of the many applications of Vogeltype Aligning Paper. Books, bulletins, house organs, proceedings of meetings, circulars, theses and lectures are now produced without the expense of type composition and engravings.



-FULL SIZE

127100

40264

40274

No.

150459 21834 Bobbin Winder Tension Bracket ...... for 150460........

Bobbin Winder Tension Bracket Nos.12403,41593 to 41596,22186,12... for 150461........

150460 ----- Nos.12403,41593 to 41596, 150459 and two 2455, for 150461........

Bobbin Winder (swinging automatic, left hand) complete, Nos.41915 and 150460...

15 461 ----- Bobbin Winder Stop Latch Screw for 225382.

Bobbin Winder Tension Bracket Screw for ....

200068E 3471 225382........................

200080P 3471 Bobbin Winder Stop Latch Trip Lever Hinge Screw for 225382........

200299H 3471 Bobbin Winder Pulley Set Screw for 202473.

200280C 3471 Thread Unwinder Spool Rest Rod Set Screw for 202490........

200383C 7729 Thread Unwinder Spool Rest Set Screw for 225257........

201018C 7729 Bobbin Winder Tension Stud for 225461..... Thumb Nut for

201499B 3471 225462 ....

201572B 3471 Thread Unwinder Thread Guide Lock Nut for 225258........

201696J 7729 Bobbin Winder Frame Oil Packing (wick) for 225453........

202277 3471 Bobbin Winder Tension Spring for 225462... Pulley with 200280C, for

202407 3471 225382........................

202473 3470 Bobbin Winder Stop Latch Trip Lever for 225382........

202478 3471 Thread Unwinder Spool Stand with 200383C, for 225258........

...490 20335 Thread Unwinder Spool Rest with 201018C, for 225258........

...nwinder complete, Nos.201696J, ...267,225324,225326,225388,two ...5391 and three wood .... Rod Washer

---

ROTO JUNIOR

A Simple Self-Contained, Powerful, Efficient and Durable Air Driven Cleaner for SMALL TUBES

FREQUENT CLEANING PRACTICAL

ONLY TWO MOVING PARTS

ONE MAN OPERATION

PRINCIPLE of OPERATION

THE ROTO COMPANY

For Further Details and Prices...

TRAVEL IN THE ...

MEXICO

THE ROYAL PRIMER Improved. Being an easy and pleasant GUIDE TO THE ART of READING. PHILADELPHIA: Printed and Sold by James Chattin, in Church-Alley 1753

154

The/ Royal Primer/ Improved:/ Being [redacted] [redacted] and pleasant/Guide/ To The/ Art of Reading./ Philadelphia:/ Printed and Sold By James/ Chattin, in Church-Alley./ 1753.

[redacted] pages; 48 leaves. (A) B - F in eights.

Copies: Rosenbach Richmond Literature Co., [redacted] 28, 1913, $1225.00. [redacted] copy: Anderson Sale, February 9, 1920, $410.00.

I am somewhat acquainted with [redacted] early history of this particular Primer. Late in 1912 a Fourth Avenue dealer bought from a junk [redacted] a pushcart full of pamphlets, books and autograph letters for approximately ten dollars. A few days later I bought most of the books and pamphlets for about seven hundred dollars. The autographs were sold to another party. I did, however, find out that about ten minutes after the dealer had bought the whole lot, a certain well known scout bought the above Primer for fifteen dollars. He sold part interest to J. A. Bowden who at this time managed [redacted] Richmond Literature Company. The latter put it up at auction with the above stated result. George D. Smith [redacted] announced [redacted] buyer. If this is so or if the original scout kept his interest, I do not know. However, when it was resold, Mr Huntington lost out

110

This first American reprint of the Royal Primer differs [redacted] widely from the Newberry publications than any of the other eighteenth century American editions which have been examined by Perceval Merritt, in which in general follow the Newberry Primer very closely. Most of the cuts representing birds, animals and sacred scenes are found [redacted] in the Newberry Primer. But Pages 76 to 80 have a series of cuts of sailing vessels which have been found in no other Primer, a ship, Brigantine, scow, schooner, and sloop. Running at the bottom of these five pages is a poem by Addison entitled: An Ode to Almighty God, on a Deliverance at Sea.

155

The Royal Primer Improved: Being An Easy And Pleasant Guide To The Art Of Reading. With Twenty-Eight Cuts Adapted To Children. The Second Edition. Philadelphia: Printed by James Chattin. 1753.

Hildeburn, Volume I, page 281; Sabin 73805; Evans 7114, ci the above. No copy has been located, no collation given and would seem as if the first bibliographer derived the entry [redacted] advertisement and that others follow in recording. [redacted] other issues of this Primer. The Pennsylvania carries no advertisement in 1753 of the Chattin Roya However, in the Pennsylvania Gazette of February 2 and April 11, 1754 appears a list of books printed James Chattin, including: The royal primer imp bound, [redacted]. Ditto, bound different, [redacted].

156

The/ Royal Primer:/ Or, [redacted] easy [redacted] ple Art of Reading / Being [redacted] Introductory the Sciences / Publish'd by Authority./ . Newbery, at/ the Bible and Sun, in St Paul B. Collins/ at Salisbury (Price bound 3d.) (175

Cop

Presentation inscription on flyleaf dated 1755. Anderson Sale, January 17, 1916, $5.00.

111

VOGELTYPER

MACHINE PARTS LISTS PUBLISHED AT GREAT

DODGE MEETS ...GENCY ...ITH ...LTYPE

...Day Delay ...ant Bulletin

PRODUCTION NOTES

TYPESETTING & RET... ELIMINATED ... MACHINE OFFSET

TYPING SERVICE BEGINS in CAPITAL

RARE BOOK COLLECTORS CHECKLIST PUBLISHED

...CIRCLE SET ...PEWRITER

DODGE STATISTICAL RESEARCH SERVIC

119 WEST 40th STREET, NEW YORK, N. Y.

Based on F. W. Dodge Corporation's daily census of building and engineer... projects planned and started

June, 1935

37 EASTERN STATES

RESIDENTIAL BUILDING CONTINUES IN SPOTLIGHT

The construction industry in June turned in the best performance for any month since March 1934, when activity under the PWA program was tapering off from its peak. June contracts for total construction in the 37 eastern states amounted to $148,005,200. This represented a gain of almost 18 per cent over the total for May and almost 17 per cent over the volume reported for June of last year.

Of the June 1935 total, residential building amounted to $48,832,500; this was more than 10 per cent greater than the total for May and almost twice as large as the total reported in June 1934. In fact, the June residential building contract total was larger than was shown for any single month since October 1931. Residential b...

STATES, the CHICAGO TERRITORY, CENTRAL NORTHWEST, the ST. LOUIS TERRITORY and the KANSAS CITY DIS-TRICT.

Residential building awards during the first six months of 1935 in the 37 eastern states as a whole amounted to $208,173,600 as against only $131,747,900 for the corresponding six months of 1934. Residen... recording an advance of almost 58 per cent over the half-year total for last year the volume of residential contracts during the initial six months of 1935 was greater than has been recorded for any similar period since the total for the first half of 1931.

Non-residential building c... tracts in June amounted

DODGE STATISTICAL RESEARCH SERVIC

119 WEST 40th STREET, NEW YORK, N. Y.

Based on F. W. Dodge Corporation's daily census of building and engineer... projects planned and started

August, 1935

37 EASTERN STATES

AUGUST SHOWED FURTHER EXPANSION

The volume of construction undertaken during August was greater than for any month thus far this year. In fact, with but three exceptions, one must go back to the record for October, 1931 to find a higher volume than was reported in August.

The increase over the preceding month was chiefly due to large gains in public works of engineering types. The gain over a year ago was shared in by all major classes except public utilities.

Despite the general increase between July and August... in total construction... building showed a... previous

Contemplated constr... of all kinds reported ... but was slightly be... level shown for July.

Gains over a ye... new planning were r... each major terri... Metropolitan New Y... New York and Sout...

For the e... of 1935 the t... construction ... smaller than the corresponding ... of 1934.

Cumulative losses from ... year ago centered in non-residential building and in heavy engineering projects. Residential building scored an advance of roughly 75 per cent

---

...g Down Recovery in Factory and Commercial Building

The brewery and distillery project... of 1933 and 1934 were included in the fig... ures for food-products factories.

Although there has been a decline in the first five months of this year as compared with 1934, it is interesting to note substantial increases in iron and steel plants, mineral extraction plants (mines, quarries, etc.) and in miscellaneous factory buildings.

As indicated by the chart at the top of the page, factory alterations and additions have played a large part in the total program, accounting for two thirds of the total number of projects and 40 per cent of the total expenditures. Expenditures thus far in 1935 have been practically evenly divided between new buildings and projects for alterations and additions.

Removal of all code restrictions on increasing productive capacity should give a considerable impetus to factory modernization projects in the near future. Availability of insured modernization loans up to $50,000 under the Amended National Housing Act should give further impetus to this class of project. ...tory modernization project ... years has

FACTORY BUILDING TRENDS

Legalization of beer in 1933 gave the initial impulse to the rise in factory building volume that took place that year. Repeal of prohibition also stimulated new building and modernization of distilleries.

These facts brought about the unusual ... of recovery in factory building ... recovery

---

COMMERCIAL BUILDING TRENDS

Alterations and additions have also been quite important in the rise of commercial building volume from the low levels of 1933. In the past three years commercial building modernization has accounted for 58 per cent of the total number of projects and 43 per cent of total commercial building expenditures.

In the first five months this year commercial modernization projects have amounted to $31,307,500 compared with $29,217,200 in the first five months of 1934.

Further evidence that the recent dip in factory building is temporary in nature is shown by the long-range forecaster chart above.

This chart, based on the relationship between DODGE STATISTICS of contemplated new work and statistics of work actually started, shows the contemplated curve crossing the contract curve late in 1932, thus starting a period of accumulating shortage of factory building, as indicated by the accumulations of planned work. In plotting this chart the figures for contemplated new work are scaled down by the factor 0.613, to bring them in line with the long-time average relationship of the two sets of figures.

Further recovery of general business activity and industrial production would undoubtedly tend to increase the volume of factory building.

The table at the bottom of the page indicates that the minor decline of this year was principally in office structures; garages, stores and warehouses have all shown increases.

COMMERCIAL BUILDING CONTRACTS - 37 EASTERN STATES

Page 2 DODGE STATISTICAL RESEARCH SERVICE

The low volumes of recent years cre... e a strong presumption that there may ... deficiencies to be made up in some of ... ese classes of buildings, though defi... iencies should be measured in terms ... f present needs rather than by compar... sons with past performances.

ACCUMULATED DEMAND

Fortunately there is a rough measure of potential demand in the figures for contemplated new projects reported each month in the Dodge Statistical Research Service Bulletins.

These figures for contemplated work, in comparison with the figures for contracts awarded, are the basis of the long-range forecaster chart shown on page 3. In this chart the figures for contemplated work are multiplied by the factor 0.6115 to scale them down to their normal relationship with the contract figures.

The turning of the contemplated curve and the crossing of the two curves in 1933 started a period of accumulating plans and accumulating demand. Planning of public and community building projects was greatly accelerated in anticipation of the Federal public works program initiated that year. Only a fraction of the planned work went ahead, and the tapering off of the first public works program led to a decline in contracts from December 1934 to date.

Expectation that a fair proportion of these planned projects will result in contracts during the coming months is based upon the following considerations:

1. Under the new work relief program the Federal Administration is offering 45% grants and 4% interest to the state and local governmental agencies.
2. The municipal bond market has improved greatly, so that solvent local communities can readily finance their own needs to a much greater extent than they were able to, two years ago, many of them at rates under 4%; local communities can get needed improvements at bargain prices.

It will be noted on the long-range forecaster chart on page 3 that the contract curve has been moving upward for three months.

Page 7 DODGE STATISTICAL RESEARCH SERVICE

VOGELTYPOGRAPHY PRESENTS A NEW CHALLENGE TO THE IMAGINATION OF ALL ADVERTISING MEN

...paper stretcher has been part and parcel of the education of every printers' devil. Printers must think up a new one, because paper and type stretching are now realities. Vogeltype Aligning Paper and Vogeltype Headline Paper offer possibilities in type layout and type design limited only by the imagination of the user. Vogeltype Aligning Paper makes it possible to set copy with both margins aligned on any typewriter, without calculation or retyping, even direct from handwriting. And, believe it or not, your ordinary typewriter can now turn out italics, enlarged, condensed types, extended types, reverse italics, etc., by simply substituting Vogeltype Headline Paper for the ordinary paper you use.

These pages merely suggest some of the possibilities of this newly patented paper and process. The body matter was set with Vogeltype Aligning Paper on a standard great primer typewriter. Headlines were set and proved in straight lines on 100% Vogeltype Headline Paper and curved by stretching the paper fan shape. No adhesive was required.

WHAT IS VOGELTYPE HEADLINE PAPER?

Vogeltype Headline Paper consists of a thin, finely corrugated paper stretchable in one direction only, and mounted on a heavier backing sheet with a cement which remains tacky for a long time. Two kinds of paper are made, having 50% and 100% stretch. The former is suitable for types under 36 point, while the latter is for larger types.

Fig. 1 illustrates a small section of Vogeltype Headline Paper cut from a standard size sheet 10" x 20". Words have been typewritten at various angles. Fig. 2 shows how the types were changed by lifting the stretchable paper from the backing sheet and stretching it. Because the paper can stretch in one direction only, there is no distortion in a transverse direction. For this reason, either the height or width of letters (not both) may be increased, depending upon the position of the type. Type imprinted at an angle to the direction of the stretch will become italic or reverse italic, etc. A feature of this paper is that no matter how far it is stretched, the height of all letters on any line is the same, except for condensed types, when the width of all letters remains constant. Bold faces are secured on the typewriter by striking over the letters two or three times.

APPLICATIONS

With Vogeltype Aligning Paper and Vogeltype Headline Paper, a complete house organ, broadside, text book, report, bulletin, catalog, sales manual or similar job can be set up, ready for offset reproduction. The only equipment required is a good typewriter. Headlines or individual words set on Vogeltype Headline Paper may be inserted into copy set on Vogeltype Aligning Paper by leaving the required space for them in the copy. Both the stretchable paper and the backing paper are treated to adhere to each other, and if the blank line strips left in the copy for the captions are torn out, the headlines which are removed from the backing sheet can be adhered into position without the use of any adhesive. By using proofs of printers' type on Vogeltype Headline Paper for captions, hand-lettered effects can be secured. Vogeltype Papers were patented in the United States on February 19, 1935. They have already been adopted by some of the largest mail order houses, utilities, industrial plants, lithographers and various government departments in Washington and other parts of the country. Many of the leading educational institutions and publishers are using the process for books and theses.

USE WITH PHOTOENGRAVING

Vogeltype Headline Paper may also be used by artists in preparing work for photoengraving and thereby save hand lettering and expensive composition. Labels, cartons, and other work requiring difficult type arrangements can be easily handled. When the variety or sizes of types available is limited, the artist will especially appreciate the advantages this paper offers. The label illustrated in Fig. 4 was set up and proved on 100% Vogeltype Headline Paper exactly as shown in Fig. 3. Then, the top sheet of a blank piece of Vogeltype Headline Paper was removed, exposing the treated backing sheet. The circles and straight guide lines were drawn with a light blue pencil ... this backing ... type lines were the-...

Vogeltype Vogeltype Vogeltype VOGELTYPE

Fig. 1

Vogeltype Vogeltype Vogeltype VOGELTYPE

Fig. 2

HERALDS A NEW ERA OF FREE...

PROCEEDINGS ...

"OFF RESONANCE" HOWLS

TRACKING DOWN RECOVERY WITH LOCALIZED STATISTICS

Rates of building activity are never uniform throughout the country.

For market-analysis, production-control and sales check-up purposes, it is obviously necessary to keep track of building trends on a localized, or territorial, basis.

Successive stages of territorial breakdown of monthly building statistics are available in the 37 - States and the Regional Bulletins of Dodge Statistical Research Service. Figures are given for 13 Dodge Marketing Areas, 37 States individually, and for the 90 most important cities and the 10 most important counties.

METROPOLITAN AREAS

The special Metropolitan Areas Bulletins give in statistical table form each month the following data for 80 metropolitan areas:

Total construction.
Publicly-financed construction and privately-financed construction, separately.
Residential building, with new projects and alteration projects separated.
Non-residential building, with new projects and alteration projects separated.
Public works and utilities (heavy engineering).

Figures are given for the latest month and for the corresponding month a year preceding, cumulative total contract figures are also given.

ADVANCE FIGURES THREE TIMES A MONTH

Tabulated on the 15th, the 22nd, and the last day of the current month, current figures are regularly sent to D.S.R.S. subscribers in the form of Tri-Monthly Supplement Bulletins.

These bulletins give the earliest possible figures according to the three big general classifications: Residential, Non-residential, Public Works and Utilities. Figures are given for the 37 states as a whole and for the 13 Dodge districts. They enable subscribers to know current trends in advance of monthly bulletin publication.

COUNTIES AND SALES TERRITORIES

It is not practical to publish mont... ly bulletins giving building statisti... for all the 2,700 counties east of ... Rocky Mountains. But the Dodge stati... al records are kept so that county ... are available.

Certain subscribers have arra... receive special monthly statisti... ports by individual counties. Wi... special service it will be pos... track down construction industry... on the most detailed territoria...

For certain other subscri... sales territories do not cor... ly to the Dodge marketing ... state lines, county statisti... bled each month for the su... sales territory breakdown.

ROCKY MOUNTAIN AND P...

A supplementary se... building permits is av... Rocky Mountain and Pa... which are not covered ... hensive building con... the 37 States Bulle... tain and Pacific Co... the Dodge Statisti... as to give a comp... trends over the ... on building perm... fic Coast Citi... cities.

A service for following construction trends, making ... tion schedules and sales quotas, and checking sales p...

DODGE STATISTICAL RES...

119 WEST 40th STREET, NEW YOR...

Based on F. W. Dodge Corporation's daily census of b... projects planned and started

Page 4

... NEWS LETTER

and other items of interest this month

THE "QUEEN MARY"

Photo...

This new 73,000-ton Cunard White Star liner will be equipped with ... by WAYGOOD-OTIS micro leveling elevators. There will be eleven elevators for passenger service, two for baggage, three for stores, and four for miscellaneous purposes. London office reports that all elevators can be operated from the ship's emergency electrical supply should the main supply be interrupted, and that, for the first time on any liner, all elevator machines are identical, necessitating only a small supply of spare parts.

With the completion of the Queen Mary, the five largest ships afloat will be served by Otis elevators. The other four are the Normandie (French), Majestic (British), Berengaria (British) and Bremen (German).

BONDS

OF THE PEOPLE OF

PUERTO RICO

...ion of the United States)

These bonds have as complete exemption from taxation as United States Liberty 3 1/2s, and are exempt from taxation by any State in the United States or by any Municipal or Political Subdivision.

Principal and interest payable at the Treasury of the United States, Washington, D.C., with the exception of two issues, which are payable at the Office of the Treasurer of Puerto Rico, San Juan, Puerto Rico.

...uthority of Acts of Congress of the United States and ...Rico, and the legality of these issues has ...f the United States.

(Data taken from Annual Report of Auditor of Puerto Rico, 1932-33)

ASSETS	Current Year, 1932 - 1933	Previous Year 1931-1932
Land and equipment	$51,604,480.95	$50,973,798.35
Cash	8,772,884.41	9,389,506.81
Sinking Funds	1,286,783.75	1,370,327.80
Trust fund reserves	2,133,771.33	1,135,899.52
Notes Receivable	1,160.00	2,490.00
Accounts Receivable	10,763,376.68	8,835,203.27
Loans to municipalities	150.00	5,375.00
Other deferred assets	164,217.87	152,123.17
Deferred debits	114,410.96	130,796.74
University of Puerto Rico	2,256,594.24	2,145,749.62
TOTAL ASSETS	$77,096,840.14	$74,343,480.28

LIABILIT...

$ 1,173,494.54 $ 379,494.54

164,803.07 4,193,348.36

...50 11,662,172.37

796.86

1,804,301.02

Novemb...
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was renamed by
Puerto Rico or

On October 18
took formal p...
General Brooke

Since Amer...
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FIGURE XVII

• MASTER COPY FOR PHOTO OFFSET PRINTING •

Business men throughout the country, particularly those known as printers, are well aware of the fact that a new printing process is here, and that very large savings are possible from its use. This new method is known as *Offset Lithography*. It is a simple process, fast and inexpensive. Illustrations can be used at no extra cost for plates. Business offices are finding it desirable to install offset presses, and many hundreds of these machines are turning out work that is satisfactory in every way. Speed and economy are the factors that create interest. Where the cost of the offset press is too much for the smaller business offices, it is the practice for such offices to make their own master copy and send same to a commercial offset house to be printed.

The great problem in Photo Offset work is met in the making of the *master copy*. The copy may be printed from type set up by a printer, composed on a linotype, written by a typewriter, or by the *Vari-typer Composing Machine*, built especially for this work. Type-set or linotype copy is too expensive, for after the matter is set up, the greatest part of the printing cost has then been incurred. Typewriting is very unsatisfactory, because only one style of type can be used on any one machine. Typewritten matter is cold and anemic to the artistic eye, and creates the very effect most business men are trying to escape. The only real composing machine which will write copy at a low cost, and at the same time absolutely delight the person interested, is the *Vari-typer*, manufactured in New York City by the Ralph C. Coxhead Corporation. It must be stated here, however, that as with most machines, the degree of satisfaction will vary with the intelligence and artistry of the operator.

The *Vari-typer* is constructed to use different type plates, of which more than sixty in English are available, and more than two-hundred in foreign languages. Type may be changed instantly. *Variable character spacing* is a feature of each machine, which means that letters may be written at as many characters to the inch as the different sizes of type make necessary, limited, of course, to 3 different spacings on any one machine. These three may be any combination of the spacings 10, 12, 14 or 16 letters to the inch. This machine also permits the use of six *different vertical or line spacings*. The keyboard is easy to operate especially if the operator has had typewriter experience as the touch system is used for both and the keyboards are almost exactly alike.

Provision is made for **LARGE BOLD HEADINGS** *and this effect is very cleverly produced. Justification of the right hand margin* requires first writing of the copy so as to determine what adjustment is necessary and to so indicate at the end of each line. This adjustment is provided for by absorption or extension in the second writing by use of a device called the *half-back spacer*. This method prevents the rivers of white space so common to justification when attempted by typewriters and which is so objectionable to good printers.

* * *

Vari-typer is manufactured in many models to meet different requirements. The special machine which the Coxhead Corporation builds for the *Photo Offset* Field, is equipped with special mechanism to handle carbon paper ribbon in addition to cotton and silk ribbons. The *carbon paper ribbons* produce remarkably clean cut work and a specially constructed ribbon, 300 feet in length, is used which is different than any other ribbon on the market. This ribbon does not travel when the space bar is used, thus producing a considerable economy.

Recently this Company produced a new type plate with all metal construction which is a great improvement over anything so far offered to the trade. It is called *Krometal* and produces copy that should please those who like artistic results. Most of the plates used on the *Vari-typer Composing Machines* are being built under the new *Krometal* process.

Writers of manuscript find many features that *Vari-typer* provides, of unusual value. The advantages that follow the ability to use *italics* in marking passages for emphasis is an example. As the machine is always loaded with two type plates, the operator may change instantly from one to the other by a simple movement of the wrist. The *variation of type* is of tremendous interest to all writers.

Statisticians, librarians, accountants are very enthusiastic over the condensation possibilities of the *Vari-typer* through the use of proper typography. Large statements may be reduced as much as 50% without detracting from the readability. One large concern in Cleveland, Ohio, we are told, uses nine *Vari-typers* on the writing of statements in *condensed form*. The results are very pleasing to executives.

Footnotes are outstanding in their effect when written with the type appropriate for this purpose.

The Coxhead Company is continually working on new styles of type and are always interested in discussing this subject with the business and professional man.

Considering the work that this composing machine does, the cost is very reasonable. It is well known that composition forms the greater part of printing prices and it does seem that the *Vari-typer* can soon save its cost to any business man interested in the subject. The fact that this machine is sold in almost every country of the world, is indication that it solves one problem of the office executive, that of doing necessary work at a saving in cost and with the desired effect.

Much thought should be given to the matter of composition for photo offset presses, as the saving to be made from the use of this process will soon disappear, if either the results are unsatisfactory, or the method used for composition proves too costly. It should not be forgotten that some reduction of copy through the camera will enhance the result.

* * *

The Uneven Right-Hand Margin

Closely related to the fact that typescript letters are of equal width is the inability of the machine to make an even right-hand margin. The linotype or monotype readjusts the spacing of the letters in a line in such a way as to make all of the lines on a page equal in length or, as it is said, to "justify" them. The typewriter cannot do this, except by one or two expensive means, which require either a special typewriter and an extra typing, or a special kind of paper.

By using the Varityper, and by resorting to two typings, an even right-hand margin can be made. On the first copy the typist makes the right-hand margin come as near the line as possible, usually missing it by not more than two or three letters long or short. Then the copy is blue-penciled to indicate places where the space can be extended or contracted. In a second typing, each line will be written exactly as it is in the first copy, except that the extra letters will be absorbed in the line by crowding the spacing between the words or letters, or a short line will be stretched out by increasing the spaces between the words or letters. Opinions differ as to whether the resulting copy looks choppy or uneven. A sample of Varitype work is shown in Figure XVII. As has been said, this process requires the use of the Varityper machine, which has a variable horizontal spacing, and of course the extra typing process adds to the composition cost for labor and proofreading. This method of justifying the right-hand margin could be used for hectographing and mimeographing as well as for photo-offset work.

There is another method which can be used for justifying the right-hand margin. The Vogeltype Aligning Paper Corporation, Federal Trust Building, Newark, New Jersey, has devised a special kind of stretchable paper cemented to a backing sheet. The copy is typed on this paper in the conventional manner without regard to alignment. After the sheet is taken from the typewriter, short lines are stretched to the correct length, as illustrated in Figure XVI. At present the paper is priced at $.24 a sheet in quantities of twenty-five sheets, with reductions in price for larger quantities. The sheets are made to contain from forty-eight to eighty lines of type each, and each line has a maximum length of 9". Separate sheets are made for vertical line spacing of three, four, four and one-half, five, and six lines to the inch. For great primer type (eighteen point), four lines to the inch give the most readable results; pica and elite type give the best results with five and six-space paper respectively. From a typographic standpoint, copy set with these spaces between the lines is more readable than when lines are set closer to each other. The typing area of the sheets ranges from 9" x 10" to 9" x 16".

A third device for justifying typescript is a mechanism in the process of development by Professor Charles C. Peters of the Pennsylvania State College. An attachment to an ordinary typewriter automatically controls the length of the line. This attachment consists essentially of a screw which progressively displaces the carriage in relation to the writing point. The justifying requires a preliminary or fair copy typing to indicate the number of spaces by which the line must be lengthened or shortened. In the format typing, the proper one of seven controls is engaged at the beginning of each line, and the excess of deficiency in length is apportioned equally among the fifty-four or so spaces. The apparatus at present writing permits lengthening or shortening by a maximum of three spaces. Pending the patenting of the device and its assignment to a commercial company, Dr. Peters will furnish a simple form of this device for use with any make of typewriter for $12.00, or a more automatic form for $25.00. Changes necessary in the typewriter itself restrict the line which may subsequently be written with it to about seven inches in the case of the 10"-typewriter. An alternative is to purchase through Dr. Peters a typewriter with the adjustment already made, for $60.00 or $75.00, depending upon the type of attachment furnished. The reader is referred to Statistical Procedures and Their Mathematical Bases, by Dr. Peters and Walter P. Van-Voohis (1935) as an example of a photo-offset book for which the master copy was prepared by Dr. Peters' device.

The Varityper and the Electromatic Typewriter

There are two special typewriters

which are at once more expensive and more useful for certain typing processes. The Varityper, mentioned above, was developed from the Hammond machine; it permits the typist to choose among a number of type faces, type sizes, and corresponding vertical and horizontal spacings. These alternatives are here tabulated and some of the faces available are shown in Figure XVIII.

TABLE X

TYPES OF VARITYPER MACHINES

A. Motor Varitypers:	
"Q"	10 and 12 and 14 characters to the inch.
"T"	10 and 12 and 16 characters to the inch.
"L"	10 and 14 and 16 characters to the inch.
"W"	12 and 14 and 16 characters to the inch.
B. Non-motor Varitypers:	
"Y"	10 and 14 characters to the inch.
"S"	10 characters to the inch.
"K"	12 characters to the inch.
"J"	10 and 12 characters to the inch.

Eighteen characters to the inch may be had on the "T", "L", and "W" in place of the sixteen characters to the inch, and on the "Q" in place of the fourteen, at an additional charge of $25.00 per machine. The fourteen-to-the-inch spacing and the sixteen-to-the-inch spacing are the same as those called "micro-elite" and "ultra-micro-elite" on the standard typewriters.

All type plates are priced at $5.00. each. The Varityper is sold for $210.00 to $360.00 for the power-run models, ranging from a 9"- to a 24"-carriage, and for $140.00 to $160.00 for the non-motor models, which can be obtained with a 9"-carriage only.

The Electromatic typewriter has the standard typescript faces and spacings, but makes the impression with electric power rather than finger power. It is especially useful in increasing the number of legible carbon copies, where pressure in the typewriter strokes is all-important. The Standard Electromatic typewriter is sold for $225.00 for the 12"-carriage and $250.00 for the 16"-carriage.

Typing Stages in Book Production: Draft, Fair, and Format Copies

Typing costs exhibit an interesting flexibility: they vary with the number of times a given text is retyped in the course of its preparation. In the normal production of a book the text is likely to be several times copied and corrected. Are the costs of all these typing operations to be lumped as composition costs?

The accurate study of the typewriting costs to be assessed against the multiplication of the book requires that they be separated from those incidental to the writing of the book. For purposes of clarity, therefore, three stages in the typescript preparation of a book may be distinguished from each other.

The first stage is the making of the draft copy. This is the author's product. It may be in longhand or in typescript, or in a combination of both. It is the pile of pages, often much interlined and scratched, which the writer turns over to a typist, if he can afford one.

The second stage in the preparation of the book is here called the making of the fair copy. The fair copy is the manuscript as it has been prepared for submission to an editor if the book is to be printed; it is the pile of typescript that comes back from the typist. Sometimes the author prepares his own fair copy; sometimes the so-called fair copy is not very fair. But as a normal stage in the normal

FIGURE XVIII

This is a sample mimeographed page to illustrate some of the type faces, type sizes, and corresponding vertical and horizontal spacings possible with the *Varityper machine.* This paragraph is written with *Miniature Roman type, in nine point size, with six lines to the inch.* This type lays down fourteen letters to the inch and is similar to the micro-elite type of the standard typewriter. When typing a text in which there are characters not in the Roman alphabet, the non-Roman characters may be available in a *Varityper type plate,* which costs $5.00 ($8.50 in metal).

• • •

This is a paragraph written with *Petite type in eight point size, nine lines to the inch.* This type lays down sixteen letters to the inch and corresponds to the ultra-micro-elite type of the standard typewriter. For emphasis, bold characters of the same style *as the rest of the copy* can be employed by the use of the hammer repeat key. Italic type may also be used for emphasis. This is an advantage over ordinary typing, where underlining is the only method available to indicate emphasis.

• • •

To justify the right-hand margin, a page is typed in the ordinary way on sheet of paper; then the copy is blue-pencilled to indicate places where the spaces can be extended or contracted. In the second typing, the extra letters are absorbed by crowding the spacing between the words or letters, using the half-back spacer, and the short lines are stretched out by increasing the spaces between the words or letters.

To justify the right-hand margin, a page is typed in the ordinary way on a sheet of paper; then the copy is blue-pencilled to indicate places where the spaces can be extended or contracted. In the second typing, the extra letters are absorbed by crowding the spacing between the words or letters, using the half-back spacer, and the short lines are stretched out by increasing the spaces between the words or letters.

• • •

This paragraph demonstrates the Varityper's ability to condense statistics into a smaller area than is possible with the standard typewriter using ordinary pica or elite type:

Comparison of a Quoted Printer's Estimate and a Quoted Varityper Estimate for 50 copies of a Forty-six Page Pamphlet.

Printing	Varityping
$117.50 typesetting	Varityping, justifying the lines, and running off on the Mimeograph . . . .
15.00 make up	
22.00 printing	
2.00 stock	
4.00 binding and collating	
$160.50	$60.00

• • •

250 kinds of English and foreign type, 6 to 14 point can be used on one Varityper.

THIS IS OVERSIZE PICA GOTHIC

This is MEDIUM PRINT

This is SMALL PRINT TYPE

This is ELITE GOTHIC

This is DIACRITICAL

THIS IS PETITE GOTHIC

movement of a book, this fair copy typing can be set apart from the making of the draft copy. It is a more mechanical procedure; a typist can make the fair copy, only the author can make the draft copy.

If the book is to be multiplied in typescript, a third stage will intervene, and a third typing may be necessary. The text must be transferred to the printing surface medium required by the chosen reproduction process. Also the usual one-column, double-spaced format used for the fair-copying operation may not be the most desirable format for the finished typescript book; the margins of the fair copy may be too narrow for maximum legibility in hectographing; the one-column format of the fair copy may be less desirable than a two-column one if mimeographing is decided upon; the typed letters of the fair copy may not be dark enough or clean-cut enough to photograph well for photo-offset reproduction. The final typing required to put the text in the desired format on the hectograph master sheet, the mimeograph stencil, or the master copy paper for photo-offset is called the format typing.

To summarize: the draft copy is a step in the writing of a book; the cost of making it is not a composition cost in the case of either the printed book or the typescript book. The cost of the format typing, which is always a stage in the multiplication of the typescript book, is always a true composition cost. The fair copy may be copy for the linotyper or the photo-offset typist, in which case its cost is not a true composition cost, as its making is a stage in the writing process. If it is merged with the format typing in any of the typescript bookmaking processes, it is a step in the multiplication of the book, and its cost is a true composition cost.

The Fair Copy as a Stage in the Writing Process

The author of a book is usually expected to bring his work through the fair copy stage at his own expense. The cost of preparing the fair copy depends in part upon the condition of the draft copy. There may be a variation of 20% to 33 1/3% in the typing charges due to the condition of the draft. The cost depends also upon the number of unusual symbols and figures that occur, as it takes longer to type technical and tabular material than straight non-technical text. But fundamentally the cost of preparing a fair copy from a draft is determined by the length of the manuscript.

The unit of measurement for typewriter work ought to be the keystroke, but it is usually the page of 250 to 300 words, double-spaced. The keystroke corresponds roughly to the em of linotype composition. Whereas the number of ems per word is usually only four or five, the number of keystrokes varies from six to seven.

It is estimated that in copying typescript, a standard speed ought to be from 5,500 to 11,700 keystrokes per hour, equivalent to 915 to 1950 words.[1] This should cover from three to seven pages. By gathering estimates of standard speeds and figures for wage levels, consulting advertisements in writers' manuals, and collecting specific commercial estimates from typing bureaus, a rough estimate has been made of the cost of typescript copying, per thousand words:

Estimate of Costs of Typescript Copying, per 1000 Words, in Units of More Than a 1000 Words:

Estimate of costs based on normal speeds and wage levels ($15 to $25 per week) .... $.27 to $.44

With minimum wage and maximum efficiency, $.20; with maximum wage and minimum efficiency, $.72. If typing is done by a stenographer receiving a maximum wage of $25.00 per week, the cost would be (a) at maximum efficiency, $.33; (b) at minimum efficiency, $.72; if typing is done by a secretary receiving a maximum wage of $35.00 a week, the cost would be (a) at maximum efficiency, $.46; (b) at minimum efficiency, $1.02.[2]

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[1] A typist can type about 75% as fast as this on the Varityper.

Estimates based on quotations from typing bureaus in Cleveland .... $.20 minimum
$.50 1/2 average[3]

Estimates based on quotations in writers' manuals .... $.25 to $.50
$.40 average

A consideration of these costs gives rise to the question of whether or not it would be profitable to turn over a draft copy in fairly good condition to a publisher without having a fair copy made. It must be taken for granted that printing requires a carefully prepared fair copy. If an imperfect copy is set before the linotyper, the author's correction charges mount rapidly. As a matter of fact, the author often sends to the editor a supposedly fair copy which still contains innumerable crudities and easily corrected errors. The editors of publishing houses have learned to expect this. They maintain in their offices readers who can go over the author's supposedly fair copy and make it ready for the linotyper. This service is necessarily assessed into the cost of printed books as an editorial cost. It will be seen that the typescript book may be produced without incurring this cost--and also without the perfection that results from this editorial work. If an author is subsidizing the publication of his book, he pays for the production of a perfect fair copy whether his payments go to a typist or to his publisher or both; if the book is published commercially, the charge for some stages in the making of a fair copy may be avoided by the author.

The Fair Copy as a Stage in the Multiplication of a Book: the Merging of the Fair and Format Copies

The making of the fair copy is a stage in the multiplication of a book only when it is merged with the making of the format copy for a typescript book--that is, when a format copy is made directly from a draft copy. Whether or not it is profitable to prepare the format copy directly from the draft depends on the condition of the draft copy, the format chosen, and the reproduction technique utilized.

It costs roughly 20% to 66% more to type a format copy in two columns single-spaced from a draft than it costs to type a fair copy in one column double-spaced from a draft copy. It may cost as much as 200% more to prepare a complicated format copy from a draft copy than it costs to prepare a fair copy in ordinary one-column format.

The argument in favor of merging the different typing operations is the greater the cheaper the reproduction process. Thus the typist who makes a carbon

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[2] *Fortune* says that office workers' wages have fallen off 20% since 1930. The August, 1935, issue of *Fortune* gives these interesting figures:

	1931 wages	1935 wages
Secretaries	$30 to $60 a week	$25 to $35 a week
Stenographers	$20 to $40 a week	$15 to $25 a week
Typists	$18 to $30 a week	$16 to $18 a week

These wages, transcribed into hourly wages on the basis of 38 hours a week, are:

Week	Hour
$15	$.40
18	.47
22	.58
25	.65
30	.78
35	.92

. Many give discounts of as much as 20% on manuscripts of "book length" or over 10,000 words.

FIGURE XIX

The effect of a variation in apparatus and typists' skill in the preparation of the format copy for photo-offset work is illustrated in this sample page. The page has been printed on the same press as the other pages of the book; it would not be different from other pages except for the differences in the original typings. These differences are exhibited by dividing the page into sections, each section showing the effect of the varying conditions under which the format copy was typed.

This paragraph was typed with a lightly-inked ribbon and a fairly even touch.

This paragraph was typed with a lightly-inked ribbon and a fairly light but uneven touch.

This paragraph was typed with a lightly-inked ribbon, but with a heavy touch.

This paragraph was typed with a well-inked ribbon and a light and even touch.

This paragraph was typed with a well-inked ribbon and a light but uneven touch.

This paragraph was typed with a heavily-inked ribbon and with a heavy touch. The effect is very unpleasant and hard to read.

This paragraph was typed with a heavily-inked ribbon but with a lighter more even touch.

This paragraph was typed with a heavily-inked ribbon and an uneven touch.

This paragraph was typed by a trained typist at the Edwards Brothers establishment, using a carbon ribbon and a photo-offset typewriter.

copy makes it customarily while preparing the fair copy. She does not plan to make a fair copy and then retype the whole text in order to make a couple of carbons. If she is making a hectographed edition, there will be more of an excuse for extra typing simply because the typing is a smaller proportion of the cost of the whole job. The argument is even stronger for a permissible separate format typing in the case of mimeograph, and strongest of all in the case of the rotaprint, multilith, or photo-offset processes. The shift is not technological, but due to a change in cost perspective. In relation to the expense for materials and paper involved in a long run on the rotaprint or multilith, the extra composition cost of an additional format typing seems small, while in relation to the corresponding expenses of a run of fifty hectographed copies, the additional typing charges seem large. Therefore, it can be expected that the fair copy will be used as format copy more often in hectographing than in mimeographing, and in mimeographing more than in offset work.

The Preparation of the Format Copy from the Fair Copy

Rates for preparing the format copy from the fair copy are determined by the character of the text and by the format and reproduction method chosen. As has been said, it takes longer to type technical material than non-technical, and it costs more to type in a two-column format than in a one-column one. Quotations from Cleveland typing bureaus show that a format copy in two columns may be prepared from fair copy at an additional charge of about 30%. But the reproduction method chosen is the chief factor in determining the cost of additional typing: it is just as easy to type on a hectograph master sheet as on ordinary typewriter paper and only a little more difficult to cut a mimeograph stencil. But it is more of an art to prepare master copy for photo-offset reproduction. Extra care is required on the part of the typist in order to produce copy that will retain its legibility when its size has been decreased. The best results are obtained when certain kinds of master paper and typewriter ribbons are used and when special typewriters like the Varityper or the Royal photo-offset typewriter are used; these devices and supplies are not available to the author or even to the average typing bureau, and it is for this reason that photo-offset companies usually prefer to have the master copy for photo-offset material prepared in their own establishments. The effect of a variation in apparatus and typist's skill in the preparation of the format copy for photo-offset is illustrated in Figure XIX. The page has been printed on the same press with the other pages of the book; it would not be different from other pages except for the differences in the original typing, as indicated on the sample page.

Quotations made by photo-offset establishments for preparing typed master copy for photo-offset work range from $.56 to $1.70 per 1000 words. The usual quotation is about $1.25. The $1.70 figure was given for the preparation of a special two-column format with justified lines. One company quoted $1.00 per 1000 words for technical material in units of several hundred pages.

As work of this type is definitely chargeable as composition, it is interesting to compare these rates with those of linotype composition: the wage cost for linotype composition at $1.15 per hour ranges from $.92 to $1.55 per 1000 words according to the number of ems set per hour; the shop price of linotype composition at $3.50 per machine hour ranges from $2.80 to $4.67 per 1000 words.

These possibilities of merging or shifting typescript composition costs have given rise to some inaccurate thinking on the subject of the typescript book. Sometimes a saving in composition cost seems to appear like a rabbit out of a magician's hat. The topic is sufficiently important to warrant further clarifying, which may be set up as a formula:

If A is the cost of making fair copy from
 draft copy,
 B is the cost of making format copy from
 fair copy and
 C is the cost of making format copy directly from draft copy,

will it always follow that A plus B is greater than C? Will there always be a saving in working directly from the draft copy? Obviously, the answer depends upon the actual condition of the draft copy and the rigidity of the requirements of the format copy. If the draft copy is in very good shape, and the material is to be hectographed or mimeographed in a standard typescript format, the two processes may well be merged and the extra typing saved. But if the draft copy is very rough and the format is a complicated one--such as a large two-column arrangement with footnotes--to be subjected to photographic reduction and multiplied by photo-offset, the intermediate step of making the fair copy is necessary.

In general it should be noted that if the author completes a format copy for any of the typescript book publication processes, he absorbs the entire composition cost of the process, as well as part of the editorial expense. This is not a true reduction of the publishing costs, but a concealed subsidy from the author to the publisher.

The table on the following page shows the high variation in typescript composition costs. The spread between low and high typescript costs is just as great as or greater than the spread between low and high linotype costs as analyzed in Chapter III. There is no such thing as a fixed differential in composition cost as between typescript books on the one hand and printed books on the other.

Area Costs and Format: (a) Size of Type

If the variations in the composition costs of a typescript book are the results of different possibilities in the number of times the same matter is to be retyped, variations in area costs are responsive to differences in format, to the number of words that are laid down on a page.

Three factors control the number of words on a page: the size of the type face, the interlinear spacing, and the length of the line. Except when the Varityper or the rare micro-elite and ultra-micro-elite machines are used, or the text is multiplied by the photo-offset process, the choice as to size of type face is limited to pica or elite. The special format problems arising when photo-offset can be used to reduce typescript will be analyzed in the chapter on that process.

(b) Interlinear Spacing

Common to all typescript bookmaking, however, is the problem of interlinear spacing and length of line. Interlinear spacing as a problem in typescript format corresponds to leading in relief composition. In normal size typescript the option is given between single space and double space. The standard ratchet, whether for elite or pica type, lays down six lines to the inch single-spaced, and three lines double-spaced.

Opinions differ as to the best spacing of lines. According to Horde, context is so dominant a factor in legibility that no conclusion can be drawn from the relative effects of changes in size of type and leading; Vernon's work,[4] on the contrary, has led to a conclusion on spacing--namely, that the best interlinear spacing for speed of reading book type is:

Approximately
1/10 inches (or 7 points) for 12-pt. type.
1/14 inches (or 5 points) for 9-pt. type.
1/17 inches (or 4 points) for 6-pt. type.

If elite typescript is taken as the equivalent of 10-point type, the spacing of the ordinary elite typewriter, when set for single spacing (six lines to the inch) comes very near to the ideal. The spacing of pica typescript is too narrow when set for single-spacing, too open when set for double-spacing. But special ratchets laying down four, five, and five and one-half lines to the inch are available for the standard typewriters. The price, including installation charges, varies between $1.50 to $5.00.[5] An elite typewriter set single space or a pica typewriter set special space (five lines to the inch) probably offers the most efficient and legible interlinear spacings.

But since the standard typewriter equipment does not provide this spacing and the elite typewriters are distinctly less common than the pica, the most useful information about formats must be worked out with the less efficient apparatus, namely,

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[4] Vernon, Experimental Study of Reading (Cambridge, Massachusetts, 1931). How these spaces are measured is not clear. They probably do not correspond to the leading distances of typography, but ignore the descending letters (f, g, j, p, q, y). The writer has so interpreted them.

[5] Remington, $3.00; Royal, $1.50; Underwood, $5.00; L. C. Smith, $2.25 (Cleveland prices).

TABLE XI

SHOWING HIGH VARIATION IN TYPESCRIPT COMPOSITION COSTS PER ONE THOUSAND WORDS IN PREPARING A TYPESCRIPT BOOK OF 100,000 WORDS

FAIR COPY	FORMAT COPY
1. One-column, straight matter, typed by typist at low wage and high efficiency .... $.20	1. One-column, straight matter, made from fair copy and typed at typing bureau estimates .... $.50
2. One-column, straight matter, typed by typist at high wage and high efficiency .... $.33	2. Two-column, straight matter, made from draft copy and typed at typing bureau estimates .... $.80
3. One-column, straight matter, typed at typing bureau estimates .... $.40	3. One-column, straight matter, made from fair copy and typed by typist at normal wages and normal efficiency for photo-offset work .... $.85
4. One-column, straight matter, typed by typist at low wage and low efficiency .... $.48	4. One-column, straight matter, made from fair copy and typed at typing bureau estimates for photo-offset work .... $.90
5. One column, straight matter, typed from bad draft copy at typing bureau estimates .... $.60	5. One-column, technical symbols, made from fair copy and typed by typist at normal wage and normal efficiency for photo-offset work . $1.00
6. Two-column, straight matter, typed by typist at normal wage and normal efficiency .... $.65	6. Two-column, straight matter, typed by typist at normal wage and normal efficiency for photo-offset work $1.00
7. Two-column, straight matter, typed at typing bureau estimates .... $.70	7. One-column, straight matter, made from fair copy and cut on mimeograph stencils at typing bureau estimates $1.00
8. One-column, straight matter, typed by typist at high wage and low efficiency .... $.72	8. One-column, straight matter, made from fair copy and typed by photo-offset concern at quoted prices $1.25
9. One-column, many technical terms and unusual symbols, typed at typing bureau estimates .... $.75	9. One-column, technical symbols, made from fair copy and typed by photo-offset concern at quoted prices $1.50
10. Two-column, technical matter, typed by typist at normal wage and normal efficiency .... $.90	10. Two-column, straight matter, typed by photo-offset concern at quoted prices .... $.56 to $1.50
11. Two-column, technical matter, typed at typing bureau estimates ..$1.00	11. Two-column, technical matter, typed by typist at normal wage and normal efficiency for photo-offset work $1.50
	12. Two-column, straight matter, made from draft copy and cut on mimeograph stencil at typing bureau estimates $1.50
	13. One-column, straight matter, made from fair copy, with justified lines and typed by photo-offset concern at quoted prices $1.70
	14. Two-column, technical matter, typed by photo-offset concern at quoted prices .... $1.50 to $2.00
	15. Two-column, technical matter, with justified lines, typed by photo-offset concern at quoted prices .... $2.00 to $2.50

pica typescript set either single or double space.

(c) Length of Line

Experimental evidence summarized by Vernon shows that the length of a line should not be greater than 10cm. or less than 7.5cm. (2.9" to 3.9"). Edwards Brothers in their Manual of Lithoprinting[6] hold that a maximum length of line is determined by the formula N 30/72 where N is the type size in points--a formula which yields the result that 5"-5.8" is the maximum length of line for pica type, 3.3"-4.2" for elite type. These standards yield interesting results when applied to the smaller sizes of print or photographically reduced typescript. For straight typing in full size they suggest the conclusion which must already have come to the minds of many readers--that the standard typewriter page 8 1/2" wide must be used with wide margins if the script is to be legible. Since under some conditions wide margins are wasteful, there results a certain disharmony between the interests of economy and legibility in respect of length of line. This waste is greater in the case of elite typescript, where the interlinear spacing is more economical, than in the case of pica typescript. The wastefulness in length of line can be overcome by setting up a page format in two columns--though this increases composition costs even while it reduces area costs.

In the following chapter on carbon copying, hectographing, mimeographing, and photo-offset reproduction, certain alternative formats will be presented, together with the cost differentials that separate them. The reader can judge whether the difference in legibility is worth the cost.

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[6] February, 1932 edition, p. 4.

CHAPTER V

THE TYPESCRIPT BOOK OR MEMORANDUM: REPRODUCTION TECHNIQUES

I. Carbon Paper Copying

Carbon paper offers one of the oldest and cheapest means of multiplying typescript in a very few copies. It is constantly used for thesis work. With ordinary skill and an ordinary typewriter, two carbons can be made with high legibility and at a maximum price of $.05 per page per extra carbon. The number of legible copies can be increased by increasing the force of the typewriter stroke or diminishing the thickness of the paper. The Electromatic typewriter, which uses electric power in making the impression, exhibits great efficiencies here. The following table indicates the number of carbons that can be made with one typing and the corresponding weights of carbon paper and copy paper.

TABLE XII

NUMBER OF CARBONS POSSIBLE WITH ONE TYPING

No. of Copies	Weight of Paper	Weight of Carbon Paper
1-5	Over 9 lb. to 16 lb.	7-8 lb. (standard)
5-10	9 lb. onionskin	5-5 1/2 lb. (medium)
10-20 (Electromatic)	9 lb. onionskin	4 lb. (light)

The thin paper will increase the number of legible copies, but it is useful only for multiplying ephemeral material; it will not make a book paper. The limit to the number of carbon copies that can be made into typescript books is set by the paper. A paper thin enough to receive with fair legibility the seventh copy from an ordinary typewriter, or the twenty-fifth from an Electromatic, would be too thin for book use.

Of the two elements of first cost, the composition costs are the labor costs of the fair copy typing; the area costs, which vary with the number of pages and hence with the number of words put on a single page, are those of the paper on which the fair copy is made; the running costs are those incurred in producing additional carbons.

For purposes of convenience in estimating composition costs for ordinary typing of manuscripts, a normal cost has been estimated on the basis of labor at $.40 per hour, paper for the fair copy typing at $1.25 per 1000 sheets, onionskin at $2.50 per 1000 sheets, and carbon paper at $2.50 per 100 sheets. Quotations received by the Joint Committee show that prices and costs are highly variable, as indicated by Table XIII on the following page.

A normal cost may be taken as $.40 per 1000 words and an additional charge of $.02 1/2 per page per extra carbon, with the usual 20% discount given on materials for manuscripts of over 10,000 words and no charge for the materials required to produce the fair copy and the first carbon. In both cases the format chosen is the usual 300-word page of double-spaced pica typescript.

Before the technological limit of carbon paper copying is reached, the border is crossed to the field of the hectograph.

II. The Hectograph Process

In this report the term hectographing is used to designate any process by which approximately 100 to 150 copies of a document may be reproduced in methyl-violet

TABLE XIII

VARIATION OF NORMAL COST OF LABOR AND MATERIALS IN ESTIMATING COMPOSITION COSTS IN CARBON COPYING

	Low	Normal	High
Labor per hour	$ .20 .32 1/2	$ .40	$ .50 .60 1.50
Paper per 1000 sheets	.70	1.25	1.60 2.90 3.55 8.40) 9.86) Japanese linen 10.50)
Onionskin per 1000 sheets	1.30 1.40	2.50	2.67 3.10 3.90 5.00
Carbon paper per 100 sheets	1.35 .75	2.50	3.50 4.00

TABLE XIV

A. CARBON COPY BOOKS: COST OF BOOK OF 100,000 WORDS, 334 PAGES

	Fair Copy	Fair Copy and 1 Carbon	Fair Copy and 2 Carbons	Fair Copy and 3 Carbons	Fair Copy and 4 Carbons
Edition	1	2	3	4	5
Edition Costs	$40.00	$40.00	$46.93	$53.86	$60.79
Unit Costs	40.00	20.00	15.65	13.47	12.16

	Fair Copy and 5 Carbons	Fair Copy and 6 Carbons	Fair Copy and 7 Carbons	Fair Copy and 8 Carbons
Edition	6	7	8	9
Edition Costs	$67.72	$74.65	$81.58	$88.51
Unit Costs	11.29	10.67	10.20	9.84

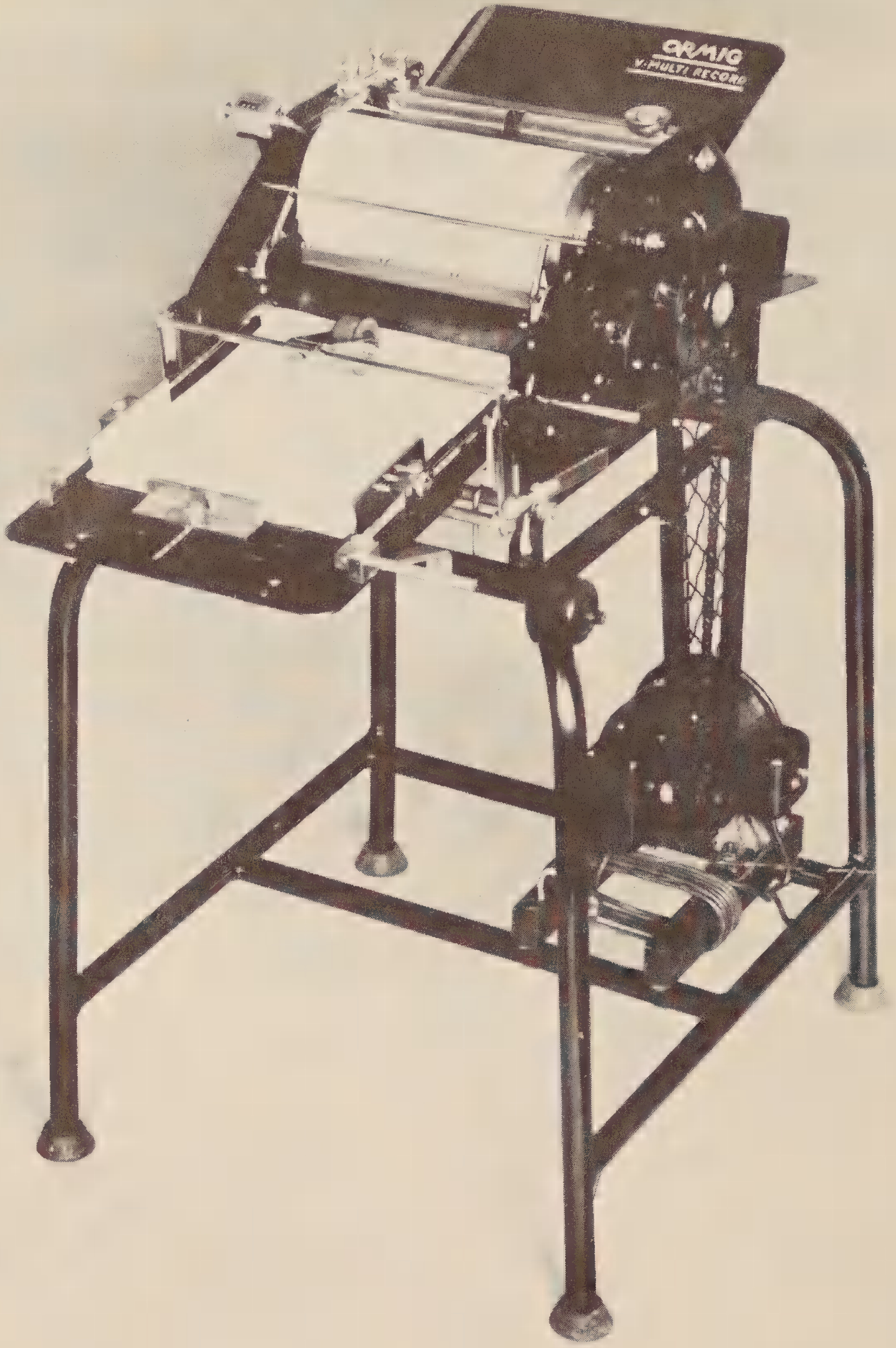
ORMIG
V-MULTI RECORD

FIGURE XX

The Ormig Duplicator

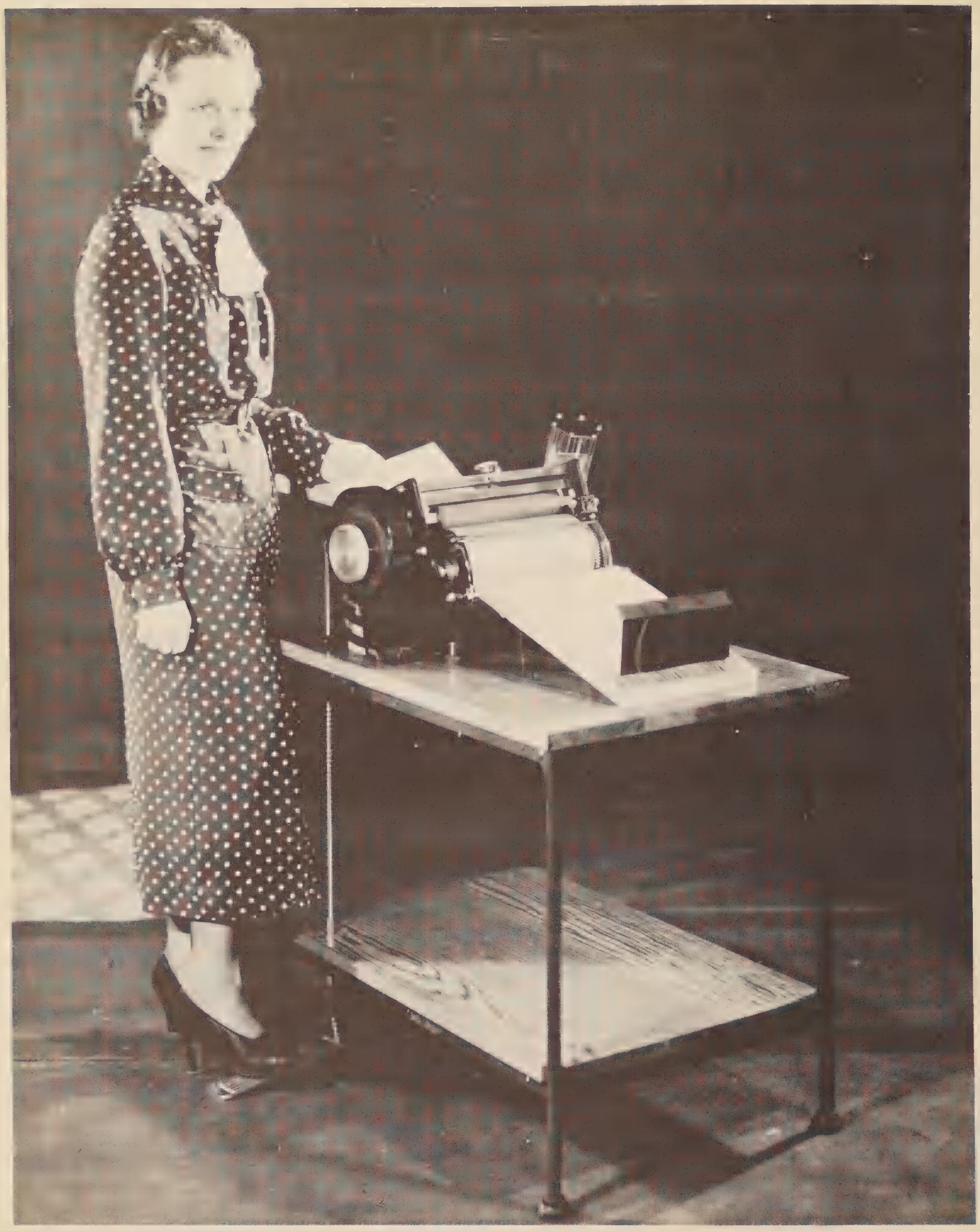

FIGURE XXI

The Standard New Process Duplicator

TABLE XIV (Continued)

B. CARBON COPY BOOKS: PRICE OF BOOK OF 100,000 WORDS, 334 PAGES
(typing bureau estimates)

	Fair Copy	Fair Copy and 1 Carbon	Fair Copy and 2 Carbons	Fair Copy and 3 Carbons	Fair Copy and 4 Carbons
Edition	1	2	3	4	5
Edition Costs	$50.00	$50.00	$56.93	$63.86	$70.79
Unit Costs	50.00	25.00	18.98	15.97	14.16

	Fair Copy and 5 Carbons	Fair Copy and 6 Carbons	Fair Copy and 7 Carbons	Fair Copy and 8 Carbons
Edition	6	7	8	9
Edition Costs	$77.72	$84.65	$91.58	$98.51
Unit Costs	12.96	12.09	11.45	10.95

dye from a single master sheet.

a) Gelatin Hectograph Process

When a sheet of paper (which we will call a master sheet) bearing a text written or typed in methyl violet dye is pressed down upon a gelatin surface, the methyl-violet image transfers itself to the gelatin. If fresh sheets of paper are then successively pressed against the gelatin, the methyl-violet image transfers itself to them. Thus a number of copies of the original are produced.

Equipment for the gelatin process ranges from the little gelatin pan, on which the menu of the thirty-five cent lunch restaurant is made, to a power-run machine with a rotary drum resembling the mimeograph. The Ditto, the Speedograph, the Vivid Duplicator, and the Standard Rotary Duplicator are among the best-known gelatin process machines. They vary in price from $15.00 for a flat-bed machine to $475.00 for a power-operated rotary one. The gelatin for the rotary models is furnished in the form of films 9" x 15" in size, which are fastened to the drum of the machine as stencils are fastened on the mimeograph cylinder; the larger, flat-bed equipment employs a roll with a cloth or fiber backing, 9" to 18" wide and about 15' long.

b) Liquid Hectograph Process

A second type of hectograph equipment dispenses with the gelatin. A piece of hectograph carbon paper is placed behind the master sheet, with the carbon side toward the master paper while the text is being written or typed. A reversed carbon image is thus produced on the back of the master sheet. The master sheet is fastened to the cylinder of the machine and the copy is reproduced by bringing the side bearing the carbon image in contact with fresh sheets of paper, which are moistened with a special duplicating fluid as they are fed into the machine.

There are three kinds of liquid process equipment: the Ormig (Figure XX), made in Germany and sold for $160.00 to $475.00; the Standard New Process Duplicator (Figure XXI), which sells for $187.50 to $440.00; and the Ditto Liquid Duplicator, fixed at $200.00 for the hand-run model and $265.00 for the power-run machine.

The Joint Committee has experimented with both the liquid process and the gelatin machines. The result of extensive comparison in the practical working of the two processes is definitely in favor of the liquid process as against the gelatin for the following reasons:

1) Quality of Product: In the gelatin method, copies in the same run are never uniform in shade and are always lighter than the corresponding copies done by the liquid process. The age, condition, and preparation of the gelatin have a much more important effect on the quality of the copies done by the gelatin method than do the same factors of the carbon in the liquid process.

2) Permanence: Copies produced by the liquid process are more permanent than those produced by the gelatin method, because the liquid practically dyes the ink into the fibers of the paper, while the gelatin merely deposits the dye on the surface of the paper.

3) Speed: The rotary liquid machine is capable of producing many more copies per minute than the flat-bed or rotary gelatin equipment. The time for preparing for the gelatin run is almost equal to the actual running time of the liquid machine.

4) Simplicity of Operation: With the liquid method, only three operations are necessary--typing the original, clipping it in place, and turning the handle, or pressing the foot pedal, to produce the copies. The gelatin machine requires much more preparation.

5) Reprint Economies: Reprints from the original master sheet are feasible with the liquid process (but not recommended for a very long run); they are impossible with the gelatin method.

6) Gelatin Supply: It is necessary to have on hand as many fresh gelatin films as there are master sheets to be run in close succession, for a used film must be allowed to stand from six to twenty-four hours before the dye is sufficiently absorbed and dissipated to allow a new master image to be imposed upon it. If a 100-page document were to be hectographed by the gelatin process in a single day, a supply of at least fifty films would be necessary.

The variable elements in the gelatin process are so much greater than the variables in the liquid process that exact cost comparisons are unreliable. There are no decisive reasons for expecting the gelatin process to operate at a substantially lower cost than the liquid method.

The prices of special supplies for the gelatin process are listed below. Where the gelatin process equipment is already available, it can be used; but the calculation of the place of hectographing in the reproduction of typescript is based on the use of the liquid process.

Hectograph typewriter ribbon	$ .75 to $1.00 each
Gelatin rolls (15')	4.00 to 6.00 each
Gelatin films (9" x 15")	$.50 to 1.00 each

Cost Analysis of Hectographing: (a) Composition and Running Costs

Composition and running costs for hectographing require little analysis. Fair and format typings are merged, and composition costs for typing may be figured at the normal typing rates. Labor, copy paper, and liquid charges comprise the running costs. Liquid for the hectograph process is sold for $2.50 to $3.50 per gallon. A gallon will serve to moisten at least 6,000 sheets of copy paper or as many as 10,000 sheets; it makes no difference whether these are run as 25 copies each of 240 separate pages of text, or 150 copies each of 40 different masters. The highly calendered copy paper required for the best results may be purchased for $1.65 in quantities of 1000 sheets, with reductions in price starting at 10,000 sheets. For less attractive but perfectly legible work, ordinary bond paper at a slightly lower price per 1000 sheets is satisfactory, but as it absorbs more fluid than the regular copy paper it is really not economical.

(b) Area Costs and Legibility

Area costs are those of the master sheets ($1.50 to $3.00 per 1000 sheets) and the hectograph carbon paper ($.04 to $.06 per sheet in quantities of 100). These

FIGURE XXII

This sample page has been made [illegible] a Standard [illegible] Duplicator, a gelatin machine. It is claimed that [illegible] as 200 legible copies may be obtained from one [illegible] sheet. This is the 84 copy from the master sheet [illegible] gelatin film is made in a 9" x 15" size and is placed [illegible] the machine much the same as [illegible] stencil is placed on [illegible] drum of a Mimeograph machine. The gelatin film is [illegible] subjected to the strain of winding and unwinding, such [illegible] is necessary with the gelatin roll

Gelatin cost is determined by several factors, [illegible] them being the number of copies run, the length [illegible] run the quality of work desired, and the color [illegible] is claimed that the Standard Duplicator film [illegible] for a total run of 4,000 sheets before it [illegible] If red ink is used, the film [illegible] roll will [illegible] out faster than if purple ink is used Gelatin cost [illegible] as constant a cost factor [illegible] hectograph fluid cost.

The methods of making master sheets for all typ[illegible] gelatin machines are: pencils, ink, ribbons, and carb[illegible] All of these methods may be combined in a single shee[illegible] which will reproduce copies at one operation [illegible] cost is governed by the number of words, while [illegible] cost is determined by page area.

FIGURE XXIIIa

This is a sample page made by the hectograph liquid process on a Standard New Process machine costing $187.00. This is the 74 copy from the master sheet. To produce a book of 50,000 words by this process, using this format, would cost $60.00 for an edition of 100 copies (not including binding). The carbon used for this page, New Process Duplicating carbon paper, costs $4.50 in quantities of 100 sheets, with reductions in price as the quantity increases.

A comparison of this page with Figure XXIIIb will give the reader an opportunity to observe the legibility of copies taken from two different places in runs; an examination of Figure XXII (the product of the gelatin hectograph process) will bring out the main points of difference between the products of the two hectograph methods.

Standard Duplicator copy paper, used for this work, costs $1.60 per 1000 sheets, with reductions in price starting at the 10,000 mark. It is a 20# highly absorbent paper manufactured especially for hectograph work.

The BX Duplicating fluid used with the Standard New Process machines costs $2.75 a gallon in six gallon lots, $3.25 a gallon for smaller quantities. A gallon will moisten at least 6,000 copies, or as many as 10,000.

FIGURE XXIIIb

This is a sample page made by the hectograph [illegible] process on a Standard New Process machine costing $187.00. This is the 176 copy from the master sheet. To produce a book of 50,000 words by this process, using this format, would cost $60,00 for an edition of 100 copies (not including binding). The carbon used for this page, New Process Duplicating carbon paper, costs $4.50 in quantities of 100 sheets, with reductions in price as the Quantity increases

A comparison of this page with Figure XXIIIa will give the reader an opportunity to boserve the legibility of copies taken from two different places in runs; an examination of Figure XXII (the product of the gelatin hectograph process) will bring out the main points of difference between the products of the two hectograph methods.

Standard Duplicator copy paper, used for this work, costs $1.60 per 1000 sheets,with reductions in price starting at the 10,000 makr. It is a 20# highly absorbent paper manufactured especially for hectograph work.

The BX Duplicating fluid used with the Standard New Process machines costs $2.75 a gallon in six gallon lots, $3.25 a gallon for smaller quantities. A gallon will moisten at least 6,000 copies, or as many as 10,000.

FIGURE XXIV

This page is a sample of the hectograph work made with No.3-M Ormig carbon costing $4.00 per 100 sheets, with a reduction in price for larger quantities. This is the copy from the master sheet.

Ormig duplicators range in price from $165.00 to $285.00 for the hand operated machines, and $395.00 to $495.00 for the electrically operated machines. The V-5 models take maximum size sheets 9" X 14" and the larger models V-6 takes sheets up to 14" X 17".

The Ormigtin (liquid) needed for producing the copies cost $2.50 a gallon; a gallon is sufficient to moisten 15,000 sheets of copy paper.

There are three grades of carbon to suit different lenghts and sharpness of run. No.3 carbon from 1 to 75 copies. No.3-M up to 200 copies, and No.H-2 for 200 copies and over. These carbons are all priced the same.

costs are the ones most subject to variation and they are the most important on account of their relationship to legibility. If a saving in area costs is attempted by using single rather than double-spaced typescript to get more words on the master sheet, the legibility of the product diminishes accordingly, but a more important consideration is the efficient use of the hectograph carbon paper. For the most legible results carbon paper should be used only once. Of course if the typewriter is set for double-spacing, the carbon may be used the second time with no decrease in legibility by typing between the lines of the first copy. Carbon paper may be used as many as three times, but with greatly decreasing contrast and sharpness of definition in the letters produced. The following summary of the cost of the dye in relation to legibility may be made:

a) High contrast (first use)
$.04 to $.06 per page; average $.045
b) Medium contrast (second use)
$.02 to $.03 per page; average $.0225
c) Low contrast (third use)
$.01 to $.01 1/2 per page; average $.015

Length of run is also a factor in determining the legibility of hectographed matter: the first few gelatin copies are brighter than the later ones, the diminishing contrast being due to the gradual exhaustion of the supply of dye; with the liquid process the decrease in legibility begins after the 100 or 150 mark is reached. This diminution in contrast may be regulated somewhat, however, as the operation of the liquid process machines may be modified to yield a few more brilliant copies or a greater number of paler ones, and as the carbon papers are sold in various grades--i.e., hard, medium, and soft--adapted for runs of varying length.

The efficiency range of the hectograph begins with the five or six copies where it crosses the carbon paper technique and runs up toward 200. Bound in place here are four samples of hectograph work. They are numbered to indicate their place in the run. Figure XXII is made with the gelatin process; note that the letters are smoother and more blurred than those made by the liquid process. Figures XXIIIa and XXIIIb are made with the Standard New Process Duplicator, one page being taken from an early place in a run, the other being selected from a later part of the run. A comparison of these two pages will show the difference in legibility of work taken from two different places in runs. Figure XXIV is made with the Ormig liquid duplicator. By comparing these four sample pages, the reader will be able to note the variations between the products of the gelatin and liquid hectograph processes, and to estimate the curve of diminishing legibility as the number of copies taken from the master sheet increases.

The table below shows the cost of hectographing by the liquid process a book of 100,000 words, with typing figured at $.50 per hour, labor for running the duplicating machine figured at $.40 an hour, a fresh sheet of carbon used for each master sheet, and hectograph copy paper used for the run. The best possible hectographed product will result.

TABLE XV

COST OF BOOK OF 100,000 WORDS, 334 PAGES, MADE BY LIQUID PROCESS HECTOGRAPH

Edition	10	15	20	25	35*	50*	75*	100*	150*
Edition Costs	$77.76	$82.26	$87.48	$91.16	$96.08	$107.28	$127.01	$146.11	$182.06
Unit Costs	7.78	5.49	4.38	3.65	2.75	2.15	1.70	1.47	1.27

*Paper at $1.25 per 1000 in lots of 10,000 or more.

c) Application of Hectographing to the Problems of Scholarship

When compared with the average quotation for typing, these figures indicate that the hectograph will distribute the documents of internal circulation among scholars at prices so nearly within the range of those that authors are accustomed to assume in connection with the preparation of their typescript manuscripts, that the cost of giving a limited distribution in hectographed form could be assumed by the writers themselves with little more trouble than they now take in distributing reprints of their articles from periodicals.

An experiment in the use of this method as a means of reproducing doctoral dissertations has been sponsored by the Joint Committee. Dr. Stanton Davis of the Case School of Applied Science in Cleveland prepared by the liquid hectograph process an edition of fifty of a 350-page dissertation, "Pennsylvania Politics, 1860-63," at a unit cost of $1.95. Additional expenses for binding amounted to $32.50, and mailing to eighteen libraries cost $6.72. The reader may examine this work at one of the following libraries:

- Carnegie Library of Pittsburgh
- Cleveland Public Library
- Columbia University Library
- Duke University Library
- Free Library of Philadelphia
- Harvard College Library
- Historical Society of Pennsylvania
- Historical Society of Western Pennsylvania
- Library of Congress
- New York Public Library
- Princeton University Library
- University of California Library
- University of Chicago Library
- University of Pennsylvania Library
- University of Pittsburgh Library
- University of Wisconsin Library
- Western Reserve University Library
- Yale University Library

A few copies are available for sale at the Western Reserve University Bookstore at $3.00 (paper binding) and $3.75 (cloth binding). The hectograph costs, exclusive of binding and mailing, for an edition of fifty were $47.10 more than the cost for a typescript copy and one carbon.

The hectograph process is probably more serviceable, however, as a means of distributing the type of material that would otherwise be printed in pamphlet form or as articles in periodicals. No binding costs other than simple wire stapling need intervene to increase the charge upon the author; hectographed memoranda up to twenty or thirty pages in length would probably find their place of storage in a vertical file. An example of this use of the process is the reproduction by the Joint Committee office of Dr. Robert C. Binkley's thirty-four-page memorandum, "New Tools, New Recruits for the Republic of Letter," at a unit cost of $.17.

Hectographing is not recommended as a means of preserving original source material because of the impermanence of the dye, which fades rapidly if exposed to sunlight for any length of time. However, the kind of monographic work that becomes out of date in thirty or forty years may be circulated in hectographed form without loss to scholarship from its impermanence. If a single standard carbon copy is made while typing the hectograph master sheet, this copy can be deposited and held for permanence.

III. Mimeograph Techniques: Mimeographing and Direct-Typing Offset Printing

The mimeograph process multiplies typescript by means of a stencil printing surface on which the letters of the format copy are cut by the typewriter. The stencil is fastened on a cylinder, and as sheets of paper are fed into the machine an impression is produced on the copy paper by the squeezing of ink through the abraded portions of the stencil. The equipment ranges in price from $30.00 to $375.00 for a hand-run machine and from $255.00 to $450.00 for an electrically operated model with an automatic feed. The preparation of the printing surface is almost as simple as ordinary typewriting, and the machine can be operated by the lowliest office boy, so that although this form of duplicating is commercialized by service agencies, almost every office of any size possesses a mimeograph of its own. Both costs and prices, therefore, must be analyzed for mimeograph work.

The rotaprint and multilith have been briefly mentioned in Chapter III in connection with the discussion of photo-offset as a reprinting method. The press plates for reprinting are, of course, prepared photographically. But there is an alternative way of putting on such plates the format copy of the text to be reproduced: the metal sheets that are used on these small offset presses can be inserted in a typewriter as if they were sheets of paper, to receive typescript directly. The making of typescript books from press plates prepared in this manner is called "direct-typing" offset, as compared with photo-offset. Direct-typing offset is much less common than photo-offset but also much cheaper, and it is, therefore, worthy of consideration by any institution possessing sufficient resources to purchase a rotaprint or a multilith for either commercial or non-commercial use. For the benefit of owners and non-owners, both costs and prices will be quoted.

From the standpoint of cost behavior, mimeographing and direct-typing offset are very closely related. They will, therefore, be referred to henceforth in this report as the "mimeograph" techniques, and their costs will be analyzed together.

Composition Cost Analysis

It will be seen that the cost of the printing surface (or the area cost) for the mimeograph processes, whether of stencil or metal sheet, is considerably more than the cost of the printing surface used with the hectograph, and that it differs from ordinary paper in its physical character. There is, therefore, a greater likelihood in mimeographing than in hectographing that there will be three typing processes. The author will have a fair copy made from his draft copy, and then a format typing will be necessary to transfer the text to the metal sheet or stencil. This is not technologically necessary, for the typist could work directly from a draft copy to a mimeograph stencil; but this extra format typing is so often done that most of the quotations presuppose it.

Precisely because the area cost is significant in mimeographing, the problem of format must be studied; for it becomes important to lay down as much as possible on a given area, without unduly sacrificing legibility and beauty. But it goes without saying that any format differing from the usual one-column, six-line-to-the-inch, pica or elite typescript format will be more expensive to prepare. In estimating the average mimeographing costs, therefore, format typing will be charged at $.80 per 1000 words in order to provide for the slowing up that is necessary to produce an unusual typescript page. The specifications for satisfactory mimeograph formats will be discussed in connection with area costs.

Area Costs and Format

Mimeograph stencils are of five kinds and are sold in two standard sizes, 8 1/2" x 11" and 8 1/2" x 14". The prices as standardized in the trade are given below. Bootleg dealers sometimes sell stencils manufactured in violation of patent rights at half these prices. The patent rights will expire within the next decade, but by that time technology may have moved far beyond the mimeograph. Large government orders are filled at discounts up to 50% in competitive bidding.

TABLE XVI

PRICES OF MIMEOGRAPH STENCILS

	Per Quire	Each
Wax stencil		
8 1/2" x 11"	$1.25	$.05 1/4
8 1/2" x 14"	1.50	.06 1/4
Dermatype stencil		
8 1/2" x 11"	3.00	.12 1/2
8 1/2" x 14"	3.50	.14 1/2
Cellotype stencil		
8 1/2" x 11"	3.00	.12 1/2
8 1/2" x 14"	3.25	.13 1/2
Mimeotype stencil		
8 1/2" x 11"	3.25	.13 1/2
8 1/2" x 14"	3.50	.14 1/2
Dermaprint stencil (unsensitized)		
8 1/2" x 11"	3.00	.12 1/2
8 1/2" x 14"	3.50	.14 1/2

The wax stencil is used for runs

not exceeding 500. It cannot be saved, and more care is needed to produce a good copy with the wax stencil than with the mimeotype stencil. A sample of work done on a wax stencil is seen in Figure XXVII. The Cellotype stencil, a white stencil with a carbon back, is used when very high visibility is desired; the dermatype, a wet process stencil, is seldom used and is almost obsolete; the mimeotype stencil, referred to as the "universal stencil," is used for every purpose except the photographic work. The dermaprint stencil has been discussed at length in Chapter III.

There are two kinds of metal sheets that can be used directly in the typewriter--the rotaplate and the multilith metal sheet. The claim is made that the multilith sheet can be used over again for about three times; the rotaprint people say that they have not found any process whereby the rotaplate can be used over again with satisfactory results.

TABLE XVII

PRICES OF METAL SHEETS
(for direct typing)

	Each
Rotaprint	
8 3/8" x 11"	$.20
8 3/8" x 13"	.20
11" x 16 1/2"	.48
Multilith	
9 1/2" x 12 1/2"	.35
11" x 17"	.50
9 1/2" x 12 1/2" (duplex)	.25

TABLE XVIII

COST OF PRINTING SURFACE: PLATE PREPARED BY TYPING DIRECTLY ON THE STENCIL

Name	Size of Printing Surface	Price of One Stencil of Metal Sheet	Price per 6" x 9" page	Price per 8 1/2" x 11" Page	Price per 8 1/2" x 14" Page
Rotaprint (standard)	8 3/8" x 11"	$.20	$.20	$.20	
Rotaprint (longprint)	11" x 17"	.48	.24	.24	$.48
Rotaprint (sheetfeed)	8 3/8" x 13"	.20	.20		
Multilith	9 1/2" x 9 1/2"	.35	.175	.35	.35
Multilith	11" x 17"	.50	.25	.25	.50
Multilith (duplex, two uses)	9 1/2" x 12 1/2"	.25	.06 1/4	.125	
Mimeograph (wax)	7 1/4" x 10 1/4"	.05 1/4	.05 1/4	.05 1/4	
(wax)	7 1/4" x 14"	.06 1/4	.06 1/4	.06 1/4	.06 1/4
Mimeograph (mimeotype)	7 1/4" x 10 1/4"	.13 1/2	.13 1/2	.13 1/2	
(mimeotype	7 1/4" x 14"	.14 1/2	.14 1/2	.14 1/2	.14 1/2

FIGURE XXV

Direct typing on a Rotaplate is done by using either a special Rotaprint carbon paper in the typewriter, a Rotaprint "G" ribbon, or a Royal Photo-offset typewriter using carbon ribbon which does not require any preparatory treatment, is placed in the typewriter the same as a sheet of paper. In the typing, a very light impression against the Rotaplate should be made; a hard platen that will give a sharp outline of the characters is best. Errors are corrected in the usual manner.

When the typing is done, the sheet is dusted with a special Rotaprint powder. A small amount of liquid solution is then poured on the sheet and spread over the surface with a piece of cotton. The excess fluid is wiped off, leaving a thin coating on the surface. The Rotaplate is now ready to be used on the machine. It can be filed indefinitely.

One Rotaplate will make 25,000 or more copies. The Rotaplate used for this work costs $.20.

This sample page of direct typing Rotaprint work can be compared with Figure XXVI, which illustrates direct typing on a Multilith machine.

FIGURE XXVI

This sample page demonstrates Multilith direct typing. This page was produced by direct typing on a Multilith Duplex plate, which requires no preparation to receive the image. A special carbon typewriter ribbon was then used and the typing was done in the usual manner. The plate was then run off on the Model 1200 Multilith, at the speed of approximately 5,000 impressions per hour.

The cost of the Duplex plate was $.25, but since it is possible to use both sides of the plate the cost is reduced to $.12½ per image. The solutions necessary to prepare the plate for running were $.02½ bringing the total cost of the printing surface to $.15 an image in this form.

The surface of the duplex plate is also receptive to crayon, ink, and regular fabric typewriter ribbons of the proper inking. The surface of this plate can be used only once to each side. It is possible to obtain five to ten thousand impressions from the duplex plate.

The Multilith Zinc plate, which has a grain on only one side, is also receptive to the above mentioned methods of direct work, after being treated with a solution of Deoxit.

The cost of the zinc plate is $.35, but the surface of this plate can be cleaned, and re employed three or four times. The plate is cleaned by applying a solution of Blankrolla to the surface to wipe out the first image. It is then resensitized with a solution of Deoxit.

The life of the Multilith zinc plate direct image is from five to ten thousand impressions, but by the application of a solution called intensifier it can be extended from five to ten thousand impressions.

FIGURE XXVII

This sample page is to illustrate the use of special interlinear spacing and the use of a wax stencil. The interlinear spacing used is five lines to the inch; the stencil used is the inexpensive wax stencil costing $.05¼ each, instead of the usual Mimeotype stencil costing $.13½ each.

The length of run that is possible with the wax stencil is much less than that which can be obtained with the Mimeotype stencil, possibly 300 copies being the limit.

The preparation of the wax stencil printing surface is no more difficult than the Mimeotype printing surface. The chief danger is the creasing of the wax sheet, which would result in ink being squeezed through the abraded parts. Corrections are made in the usual manner.

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FIGURE XXVIII

This is a sample page done with micro-elite type. In this format, 800 words are contained on one page. Compare this figure with Figure XXVII, containing 400 words per page and using special interlinear spacing.

To mimeograph a book of 100,000 words in this format would mean tremendous savings in stencil cost and paper cost. Composition cost would, of course, be no less, and might even be somewhat more expensive, due to the two-column arrangement.

The inference, of course, is obvious: there is a close tieup between cost and legibility. The more money that is put into a job, the more likely it is that the resulting product will have greater legibility and be more pleasing to the eye. This brings up the problem of how we are to determine the exact point at which cost, legibility, and beauty of appearance come together in the best balance. This problem has not yet received its final analysis. It is known, however, that beyond a certain point there is no need to spend more money for increased legibility, because the factor of legibility has already reached its maximum point, and a more expensive format would add to nothing except, perhaps, the printer's profit.

In order to exhibit as many as possible of the different varieties of the mimeograph process, sample pages have been run off on various paper stocks from Rotaprint and Multilith metal sheets, and from Mimeotype and wax stencils. The reader must make allowance for the fact that paper stocks, formats and processes are all on display, and must decide for himself which differences in the sample pages are due to format variables, which to paper, and which to the reproduction methods.

The mimeograph process multiplies typescript by means of a stencil printing surface on which the letters of the format copy are cut by the typewriter; the stencil is fastened on a cylinder, and as sheets of paper are fed into the machine, an impression is produced on the copy paper by the squeezing of ink through the abraded portions of the stencil. Mimeograph equipment ranges in price from $30.00 to $375.00 for hand-run models, and from $255.00 to $450.00 for the electrically operated models with automatic feed. The preparation of the printing surface is almost as simple as ordinary typewriting, so that, although this form of duplication is commercially available through service agencies, almost every office of any size possesses its own Mimeograph machine.

The Rotaprint and the Multilith have been mentioned in connection with the discussion of photo-offset as a reprinting method. The press plates for reprinting are prepared photographically, of course, but there is an alternative way of putting on such plates the format copy of the text to be reproduced. The metal sheets that are used on these small offset presses can be inserted in a typewriter as if they were sheets of paper, to receive typescript directly. The making of typescript books from press plates prepared in this manner may perhaps be called "direct typing" offset, as compared with photo-offset. It is much less common than photo-offset, but also much less expensive, and it is therefore worthy of consideration by any institution possessing sufficient resources to purchase a Rotaprint or a Multilith for either commercial or non-commercial use.

From the standpoint of cost behaviour, mimeographing and direct typing offset are very closely related. They will therefore be referred to in this report as the "mimeograph" techniques, and their costs will be analyzed together.

This is a sample page done with micro-elite type. In this format, 800 words per page are accomodated. Compare this figure with Figure XXVII, containing 400 words per page and using special interlinear spacing.

To mimeograph a book of 100,000 words in this format would mean tremendous savings in stencil cost and paper cost. Composition cost would, of course, be no less, and might even be somewhat more expensive, due to the two-column arrangement.

The inference, of course, is obvious: there is a close tieup between cost and legibility. The more money that is put into a job, the more likely it is that the resulting product will have greater legibility and be more pleasing to the eye. This brings up the problem of how we are to determine the exact point at which cost, legibility, and

In designing a format for the maximum utilization of this surface five factors must be considered:

1. Size of page	standard 8 1/2" x 11" legal 8 1/2" x 14"
2. Size of type	pica elite
3. Interlinear spacing	3 lines to the inch 6 lines to the inch 4 1/2, 5, and 5 1/2 to the inch (special)
4. Length of line	5 inches is a highly legible line 6 inches is a normal office practice 6 1/2 inches is a crowded line
5. Top and bottom margin	2" at top and 2 1/2" at bottom is a wide margin 3/4" at top and 1" at bottom is a narrow margin

By combining these factors in various ways, there might be constructed over fifty different typescript formats. The difference in word-carrying capacity between the two extremes is very great. A hundred thousand words would go on 123 pages of 8 1/2" x 14" size, elite type, single-spaced, 6 1/2" lines, narrow-margin format; but would require 562 pages of 8 1/2" by 11" size, pica type, double-spaced, 5" lines, and a wide-margin format.

By a combination of experiment and guesswork, the writers have reached the conclusion that the formats shown in Table XIX are advisable for the number of words per page indicated.

Explanation of Sample Pages and Cost Table

In order to exhibit as many as possible of the different varieties of the mimeograph process, the sample pages following have been run off on mimeograph and bond paper of different weights, from rotaprint and multilith metal sheets and from wax and mimeotype stencils (Figures XXV to XXVIII). The reader must make allowance for the fact that paper stock, format, and process are all on display; and he must decide for himself which differences in the exhibits are due to format variables, which to paper, and which to the reproduction methods.

He may also judge from these samples whether pica type with special spacing of five lines to the inch is not just as legible as pica with standard double spacing. From a theoretical standpoint, five lines to the inch should be wholly satisfactory. This would mean that nine vertical inches of mimeograph printing surface could just as well take forty-five lines at five lines to the inch, or forty lines at four and one-half lines to the inch, as to take the twenty-seven lines that ordinary double spacing offers.

The five-lines-to-the-inch spacing would let twelve mimeograph stencils do the work of twenty stencils; the four-and-one-half-lines-to-the-inch spacing would let fourteen stencils do the work of twenty. The price of the special spacing equipment can be earned, therefore, by the economies in cost of stencils in a mimeographing job of less than 50,000 words.[1]

The cost and prices of mimeographing a manuscript of 100,000 words in each of these formats are estimated in the following chart. But in order to make the comparison of formats very clear, the estimates in this case are based on the use of the same printing surface, namely, the ordinary 8 1/2" x 11" mimeotype stencil, except with formats requiring 600 or 700 words to a page, which require an 8 1/2" x 14" stencil. In each case the cost figure is given under two alternative

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[1] For prices of special spacing equipment, see Chapter IV.

TABLE XIX

TABLE INDICATING FORMATS FOR ACCOMMODATING VARIOUS NUMBER OF WORDS PER PAGE

No. of Words per Page	Type Size	Interlinear Spacing	Length of Line	Upper and Lower Margins	Size of Paper
200	Pica	3 to inch	5 1/2"	1 1/4" upper 1 3/4" lower	8 1/2" x 11"
250	Pica	4 to inch	5 1/2"	1 1/2" upper 1 3/4" lower	8 1/2" x 11"
300	Pica	5 to inch	5 1/2"	1 1/2" upper 1 3/4" lower	8 1/2" x 11"
350	Pica	4 to inch	3 1/2" 2-column	1 1/4" upper 1 1/2" lower	8 1/2" x 11"
400 or 400	Elite Pica	5 1/2 to inch 5 to inch	5 1/2" 6"	1 1/2" upper 1 3/4" lower	8 1/2" x 11"
450	Pica	5 1/2 to inch	3 1/2" 2-column	1 1/4" upper 1 1/2" lower	8 1/2" x 11"
500	Elite	5 to inch	3 1/2" 2-column	1 1/4" upper 1 1/2" lower	8 1/2" x 11"
550	Elite	5 1/2 to inch	3 1/2" 2-column	1 1/4" upper 1 1/2" lower	8 1/2" x 11"
600	Elite	5 1/2 to inch	5 1/2"	1 1/4" upper 1 1/2" lower	8 1/2" x 14"
700	Elite	5 1/2 to inch	3 1/2" 2-column	1 3/4" upper 2" lower	8 1/2" x 14"
800	Micro-elite	6 to inch	3 1/4" 2-column	1 1/4" upper 1 3/4" lower	8 1/2" x 11"

hypotheses regarding composition cost: first, that the format copy is typed directly from the draft copy without an intervening fair copy; and second, that the fair copy is made on paper and then retyped as format copy on the mimeograph stencil. Labor for operating the duplicating machine is estimated at $.40 per hour. The choice of format would control a variation in area costs of 350% from the minimum and a corresponding variation in running costs. (See Table XX on the following page.)

These are costs based on average estimates for office work; prices vary greatly from this calculated cost basis. The comparison of cost and price, i.e., of work done in an office and work sent out, can be seen in one instance in the comparison as shown in Table XXI, page 52.

TABLE XX

MIMEOGRAPH COSTS FOR PRODUCING A BOOK OF 100,000 WORDS IN A VARIETY OF FORMATS WITH ORDINARY 8 1/2" x 11" MIMEOTYPE STENCILS (NO BINDING COSTS)*

Format	No. of Pages	A. Edition Costs--Total Cost of Edition with Format Copy Made Directly from Draft Copy						Total Cost of Edition with Format Copy Made from Fair Copy					
		50	100	200	300	500	1000	50	100	200	300	500	1000
200	500	$184.05	$211.00	$265.50	$321.40	$431.60	$714.10	$234.05	$261.00	$316.50	$371.40	$481.60	$764.10
250	400	163.30	185.00	229.30	273.60	362.30	584.00	213.30	235.00	279.30	373.60	412.30	634.00
300	334	149.81	167.94	205.19	242.44	316.54	502.39	199.81	217.94	255.19	292.44	366.54	552.39
350	286	139.94	155.47	187.53	219.59	283.31	443.31	189.94	205.47	237.53	269.59	333.31	493.31
400	250	132.33	146.00	174.05	202.20	258.30	398.45	182.33	196.00	224.05	252.20	308.30	448.45
450	223	126.88	139.04	163.97	189.30	239.66	365.41	176.88	189.04	213.97	239.30	289.66	415.41
500	200	122.10	133.00	155.60	178.20	223.40	337.00	172.10	183.00	205.60	228.20	273.40	387.00
550	182	118.40	128.43	149.69	169.75	211.27	314.87	168.40	178.43	199.69	219.75	261.27	364.87
600**	167	118.09	128.16	149.20	170.14	212.52	318.02	168.09	178.16	100.20	220.14	262.52	368.02
700**	143	112.91	121.68	140.12	158.56	195.64	288.14	162.91	171.68	190.12	208.56	245.64	338.14

Format	No. of Pages	B. Unit Costs--Cost per Copy with Format Copy Made Directly from Draft Copy						Cost per Copy, Including Two Typings with Format Copy Made from Fair Copy					
		50	100	200	300	500	1000	50	100	200	300	500	1000
200	500	3.69	2.11	1.34	1.08	.87	.72	4.69	2.61	1.59	1.24	.97	.77
250	400	3.27	1.85	1.15	.92	.73	.59	4.27	2.35	1.40	1.08	.83	.64
300	334	3.00	1.68	1.03	.81	.64	.51	4.00	2.18	1.28	.98	.74	.56
350	286	2.80	1.56	.94	.74	.57	.45	3.80	2.06	1.19	.90	.67	.50
400	250	2.65	1.46	.88	.68	.52	.40	3.65	1.96	1.13	.85	.62	.45
450	223	2.54	1.40	.82	.64	.48	.37	3.54	1.90	1.07	.80	.58	.42
500	200	2.45	1.33	.78	.60	.45	.34	3.45	1.83	1.03	.77	.55	.39
550	182	2.37	1.29	.75	.57	.43	.32	3.37	1.79	1.00	.74	.53	.37
600**	167	2.37	1.29	.75	.57	.43	.32	3.37	1.79	1.00	.74	.53	.37
700**	143	2.26	1.22	.71	.53	.40	.29	3.25	1.72	.96	.70	.50	.34

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*Costs for 50,000 words are one-half these figures.

**Need 8 1/2" x 14" stencils and paper.

TABLE XXI

COMPARISON OF OFFICE AND SHOP CHARGES FOR MIMEOGRAPHING A BOOK OF 100,000 WORDS

Format						
	A. Edition Costs, Office Charges					
	50	100	200	300	500	1000
400	$132.33	$146.00	$174.05	$202.20	$258.30	$398.45
	B. Unit Costs, Office Charges					
400	2.65	1.46	.88	.68	.52	.40
	C. Edition Prices, Shop Charges					
400	250.00	250.00	250.00	275.00	325.00	437.00
	D. Unit Prices, Shop Charges					
400	5.00	2.50	1.25	.92	.65	.44

The following table shows the costs of producing a book by each of the "mimeograph" processes in a 400-word format page, as displayed in Figure XXVII. Price estimates are based on several quotations and represent an average from which there may be a variation of 35% for the maximum and 25% for the minimum.

TABLE XXII

COSTS FOR REPRODUCING A BOOK OF 100,000 WORDS BY DIFFERENT "MIMEOGRAPH" PROCESSES IN A FORMAT YIELDING 400 WORDS TO THE PAGE*

Printing Surface	Cost per Copy When Format Copy Is Made Directly from Draft						Cost per Copy When Format Copy Is Made from Fair Copy					
	50	100	200	300	500	1000	50	100	200	300	500	1000
Mimeotype 8½" x 11" Stencil	$2.65	$1.46	$ .88	$.68	$.52	$.40	$3.65	$1.96	$1.13	$.85	$.62	$.45
Mimeograph Wax Stencil 8½" x 11"	2.24	1.26	.77	.61								
Multilith (1 use for each sheet)	3.46	1.88	1.09	.82	.60	.44	4.42	2.36	1.33	.98	.70	.48
Multilith (3 uses for each sheet)	2.54	1.42	.86	.67	.51	.39	3.30	1.80	1.05	.80	.59	.43
Rotaprint (1 use for each sheet)	2.56	1.43	.86	.67	.39	.39						

*Hoch estimates that multigraphing is about 30% higher than mimeographing, and that printing is about 70% higher than mimeographing.

IV. Photo-Offset from Typescript

The photo-offset technique has already been described in connection with the reprinting of books out of print. The same technique is available for the reproduction of typescript. Why should it be used, however, when typescript can be multiplied without an intervening photographic process?

The difference between the direct and indirect making of a typescript printing surface can be illustrated in comparing the two possible ways of using the multilith. By the first method the typist takes a metal sheet, coats it with a preparatory solution, puts it into her typewriter exactly as if it were a piece of paper, types the text on it, clips it to the drum of the multilith and reproduces it. By the second method the typist makes a copy with a strong black ribbon on paper. An operator photographs this typescript page, securing a negative on film or paper--in this case usually paper. Then the photographic negative is laid on the metal, which has meanwhile been sensitized, and strong arc lights burn in the text from the photographic negative on to the metal plate. Then at last the metal plate is put on the drum, and the multiplying of copies can begin. The additional work increases not only the labor time but also the labor rate, because the additional photographic skill is necessary. Why should the costs of all these intermediate steps be borne? Why should the area cost be so greatly increased when the end product is still a typescript book?

Justification for Increased Area Cost

If the text includes illustrations or characters that must be filled in by hand, or certain kinds of tabular or charted data, the reason for using the photographic step is clear. If, however, the text is simply typescript and nothing else, the justification of the extra cost must be found elsewhere.

There are three reasons for incurring this additional area cost: first, the plates of the larger offset presses are too big to be put into the typewriter; second, the better photo-offset presses will distribute ink more evenly and make finer letters than the mimeograph techniques (including direct-typing offset) will produce; third, the standard typescript relations of type size, length of line, interlinear spacing, and size of page are not related to the normal 10" spacing of library shelving in a way that results in the most efficient use of page areas and bookshelf footage.

Photographic Reduction of Typescript:
(a) Economies in Type Size

Typescript is wasteful of page areas because of the large size of the type. Photo-offset permits a photographic reduction of typescript in any degree.[2] Therefore, by the photo-offset process a typescript can be brought down to the equivalent of 8- and 10-point type as used in books, or to the equivalent of 7-point newsprint. A table of equivalents was suggested in Chapter IV, by which various reductions of typescript could be correlated with corresponding point sizes of book type by a photographic process.

There has been one direct study of the legibility of reduced typescript by Professor Greene of Michigan. Professor Greene came to the conclusion that what he called "seven-point typewriter type" (i.e., pica typescript reduced to 70% of full size so that it laid down fourteen letters to the inch instead of ten) was just as legible as full-sized pica typescript.[3]

The reader should be given an opportunity to test this judgment and to compare the legibility of typescript in various reductions with the legibility of book-face type. To make the comparison possible, six areas of four square inches each are filled with reading matter (Figure XXIX). The first square is filled with text in 10-point type, and typescript that will lay down the same number of words in the same area is set beside it; the second pair of squares is filled with pica typescript reduced to 80% of normal size, and with ordinary printing in 7-point type, which fills the same area with the same number of words; the third pair of squares shows that pica typescript must be reduced to 70% of full size to put the same number of words in the area that will be put there by ordinary newsprint. The reader may judge the comparative legibilities.

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[2] There is one process of photo-offset from typescript which does not permit enlargement or reduction. The typewriting is done on thin paper backed with carbon so that a heavy black letter, reinforced from the back, is made. The copy is then transferred to the photographic negative paper directly, without using a camera. The National Process Company uses this method among others. From the standpoint of design of a typescript book format, its importance is only that it brings the photolithographic metal sheet nearer the typewriter. In this respect it is related to the rotaprint or multilith processes of direct typing on the metal.

[3] E. B. Greene, "The Legibility of Typewritten Material," Journal of Applied Psychology, XVII, No. 6 (December, 1933) 713-28.

Whatever conclusions the reader may draw from these illustrations and from the exhibits of standard photo-offset typescript formats as to the permissible amount of reduction which pica typescript will take without sacrifice of legibility, the essential fact stands that reduction in size of typescript increases very rapidly the number of words that can be laid on a given page area. While the linear dimensions of the typescript are falling by an arithmetical ratio, the number of words per page is increasing by a geometrical ratio. This is the same situation that is encountered in any photographic reproduction process in which a reduction of the size of the writing is involved.

Photographic Reduction of Typescript: (b) Length of Line and Economy

There is an additional feature that makes this consideration especially important in the case of typescript, and that is the effect of reduction on length of line. There is very little reason to carry out a reduction of typescript size if a single column of typescript is still to be carried on a sheet of paper 8 1/2" x 11", because so much of what is gained in the use of space by diminishing the type size is simply turned over to wider margins. But here two possibilities intervene: the reading matter may be typed in two or more columns and reproduced on the standard typewriter size page, or the size of the page itself may be reduced to something more nearly resembling that of an ordinary octavo book.

But since an octavo page, 6" x 9", with lines of maximum length (3.9" for 6- to 10-point type, according to Vernon) sacrifices 35% of its surface to right- and left-hand margins, an 8 1/2" x 11" page, with two columns each 3 1/4" wide, which sacrifices only 23 1/2% to right- and left-hand margins, is preferable. The difference is increased by the fact that a larger side margin usually calls for larger top and bottom margins. Since the cost of printing surface is an area cost and the margin space costs just as much per square inch as the part of the page that is utilized for text, it is especially important in planning an economy format for a photo-offset typescript book that the margins shall not be made any larger than necessary. It is interesting to note in this connection that Edwards Brothers propose, for an 8 1/2" x 11" page, a two-column format with columns 3 1/2" wide, and the Donnelley & Sons Company suggests a similar format.

With these facts in mind, one may lay down the conditions under which it may be profitable to reproduce typescript by photo-offset rather than by the mimeograph process: by the increased utilization of paper and printing surface owing to reduction in size of type, and the diminution of the proportion of area given over to margins, the photo-offset process will at some point reach a cost figure that will make up for some of the additional costs of the photographic element in the process. If, for instance, the area cost of making a photo-offset page is three times the area cost of making a mimeograph page, the area cost per word will be the same only if six times as much reading matter can be put on the photo-offset page.

Specifications for Reproducing the Same Book at the Same Cost by Mimeographing and by Photo-Offset

Cost comparisons between photo-offset and mimeographing as means of reproducing typescript are complicated by the fact that photo-offset is usually shopwork sent out on contract, and, therefore, costs to the publisher must be calculated on the basis of actual price quotations by firms engaged in the printing business; while the mimeograph process is so much a part of office routine that its costs can be calculated in terms of labor and materials. The most appropriate comparisons, therefore, are those that stand between commercial mimeographing as quoted by office service shops

FIGURE XXIX

Exhibit to illustrate the comparative legibility of typescript and print face when they are so set or reduced that they lay the same amount of reading matter on the same area.

It is worth noting that among those who have studied the subject there is by no means a general agreement as to the effects of line lengths, type faces, type sizes, and leading upon the reading rate of a given material. Very little

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and commercial photo-offset quotations.

A further complication increasing the difficulty of cost comparison is the fact that any format devised to secure a maximum use of the paper surface is likely to require a special format typing; the fair-copy typing operation cannot so easily be merged with the format-copy typing as in the processes which use a simpler format. In both cases, therefore, the cost of a format typing from the fair copy will be figured into the estimates made.

An extra operation required to justify the right-hand margin also calls for calculation, whether the method used should be that of a second format typing or the special paper invented by Spielvogel (see Chapter IV). The cost of this operation will not be figured into the estimates.

Taking all of these factors into account, it seems that mimeographing 50,000 words in a format that permits 300 words to the 8 1/2" x 11" page would cost about the same as reproducing the same number of words by photo-offset in a format that reproduces 1786 words to the 8 1/2" x 11" page.

As in all problems of reproducing research materials, the rule holds that between certain limits an increase in attractiveness of text and format accompanies an increase in cost. Above the level at which photo-offset typescript costs the same as mimeographing, there are other photo-offset formats available at costs that increase until they come to exceed the cost of efficiency formats in printing.

Photo-Offset Typescript Format: Full Utilization of Printing Surface

In planning formats for the photo-offset book there must be considered a fixed set of dimensions not those of the typewriter page--namely, the dimensions of a metal sheet of the offset press. Though commercial quotations often ignore this factor, it actually enters into the cost in a very material way, for whenever a format is so designed that it fails to use the full available printing surface of the photo-offset metal sheet, energy and material are wasted. The sensitizing and preparation of the metal sheet are substantially the same whether all or merely a part of the surface is used; the waste that occurs when the page is not planned to fit the metal sheet has been discussed in Chapter III in connection with reprinting.

The ideal typescript format, from the standpoint of printshop efficiency, would be based on a page size that would divide evenly into the area of one of the larger press plates. The plates most commonly in use will take paper sheets of the following dimensions:

22" x 34"
28" x 42"
35" x 45"
36" x 48"
38" x 50"
44" x 64"
59" x 72"

The printers will sometimes say that they are controlled by the standard sizes in which book paper is available, and that it will not pay to print in any format that calls for cutting off and wasting any considerable portion of their standard paper sheets, which are usually:

17" x 22"
25" x 38"
28" x 42"
32" x 44"
35" x 45"
38" x 50"
42" x 56"
36" x 48"

This consideration is of great importance in the case of a long run, but if only 200 or 300 copies of a book are desired, the cost of the paper is so slight an element in the total cost that paper economy may in some cases be sacrificed in the interest of printing surface economy.

The relative importance of economies in utilization of metal sheet area and economies in utilization of paper is established by the fact that the first is a saving in area cost, the second a saving in running cost. The smaller the edition, the larger is the proportion of area cost and the smaller the proportion of running cost, and hence of cost of paper. In the small editions--around 100--the area cost so far preponderates over running cost that some firms give the same quotation for 100 copies as for 50 copies. In such editions wasteful use of paper is justified if it will bring equivalent economies in the use of the photo-offset metal sheet. The exact point at which it will cease to pay to waste paper for the sake of saving metal sheet printing surface can always be calculated by estimating the total price of the paper wasted and comparing it with the area cost saved.

What then is an ideal format for the photo-offset typescript book? The standard octavo printing formats (according to published figures on binding) of 6" x 9" and 6 1/4" x 9 1/4" are ill adapted to offset work because they lead either to an undue extent of margin, an undue length of line, or an inadequate use of the reducing power of the photographic process. A column of maximum width (3.9") can be printed in the 5 1/2" x 8 1/2" page with only 42.4% of the area surrendered to margins, but this volume is too small for convenient library shelving. The best format for library shelving convenience and low margin ratio would be just short of 10" high, and the narrowest page that would accept two columns would be 7 3/4" wide. Such a page would take two columns of minimum width (2.9") with 1/2" between them, and external margins of about 3/4". The percentage of area given over to margins would be about 36%. The book page would have an unusual appearance--more nearly square than an ordinary octavo page. Yet it would be very efficient (Figure XXX).

Now the curious fact emerges that despite all the variety of sizes available in photo-offset press, there is none that will take without waste of printing surface a page 9 3/4" x 7 3/4". Thus the limitations of equipment impose themselves in planning a model photo-offset page.

Planning a photo-offset page is more intricate than planning a mimeograph page because, while all the variants of length of line, interlinear spacing, margins, size of type, and number of columns are present, there are added the additional factors of a photographic reduction ratio and a layout on a photo-offset metal sheet. The format copy is typed on one size of page, the book appears in another size of page. Moreover, while the use of book type in planning a page has been made the subject of much study, the use of typescript with photo-offset has been left to rule of thumb.

To illustrate the planning of a photo-offset page, an exercise is here carried out in calculating a format for a book of 50,000 words to meet two different cost situations: first, to cost as much in an edition of 500 as low-cost printing; second, to cost as much in an edition of 500 as medium-cost mimeographing. By consulting the tables in Chapter III, it appears that an edition of this size, in an "economy format," can be printed at $365.00 (6 3/4" x 9 1/2" page size, two columns); and the same text, mimeographed in a 300-word format, will cost $158.00 (see page 51).

The question may then be asked, is photo-offset as expensive as printing? Is it as cheap as mimeographing? The answer is that it is both, and that the cost depends on the format. The format is itself the determinant of legibility, and anyone with a typewriter and a supply of paper can plan a format that will meet any price level from the lowest to the highest.

The general formula for finding a photo-offset format that will reproduce a given number of words for a given sum of money in an edition of a given size can be worked out from data already presented in this volume.

Given N (a number of words) and D (a sum of money available), from the information in Chapter IV on costs of typing, calculate the cost of making a format copy of this number of words, which will be D' (the composition cost). D minus D' will be available for photo-offset work--the area and running cost. From the tables in Chapter III, calculate the number and size of photo-offset pages that can be produced in the required number of copies for D minus D' dollars. Then lay off on these pages the desired margins, make a decision on the number of columns of print, and conclude with the dimensions in inches of space to be filled with text. Let L be the length of the column, W the width of the column, P the number of pages, and C the number of columns to a page.

N/CP is the number of words per column. The type of text may lead to the conclusion that the number of keystrokes per word is greater or smaller than six, but six can be taken as a good average. To keep the formula perfectly general, however, let K be the number of keystrokes per word (including allowance for inter-word spacing

A PROJECT FOR THE REPRODUCTION AND DISTRIBUTION OF MATERIALS FOR RESEARCH IN SMALL EDITIONS

under consideration by the

Joint Committee on Materials for Research
of the
American Council of Learned Societies
and the
Social Science Research Council

I. The Problem.

The term, materials for research, is here understood to refer to materials of three types: (1) reprints of out-of-print or rare items, — books, pamphlets, newspaper or periodical files; (2) source material of considerable bulk, which in most cases would be copied and edited, but in some cases, merely reproduced in facsimile; (3) the original work of scholars, generally in the form of monographs.

Such materials for research are at present published by agencies of three types, each specializing in publications for which a sale of different size may be expected: (1) commercial publishers ordinarily issue books of which a thousand or more copies will be sold; (2) university presses specialize in books with a total sale averaging less than a thousand copies; (3) learned societies for the most part issue books with a total sale of less than three hundred copies.

Since the cost of printing materials for research can seldom be covered by a sale of less than four hundred copies at normal prices (1.2 cents per page, or 375 words for a cent), almost all such publications as the learned societies now issue must be subsidized, usually to the extent of two-thirds of their cost. Books issued by the university presses, of which as many as six hundred copies are sold, must also ordinarily be subsidized, to the extent of one-third of their cost. Nor is the need for subsidies confined to agencies of the second and third types: commercial publishers have frequently found it necessary to ask subsidies for books for which a sale of a thousand copies cannot be anticipated. In fact, experience has shown that the publication of materials for research is seldom possible at present without a subsidy to cover at least a part of the loss incurred.

The small sale for these publications is probably due in the last analysis to the rapid advance of specialization, which has so far removed from general knowledge publications that are essential to further advance as to restrict their appreciation to specialists. But the restricted market that they might command is still further diminished by the apparent preference of American scholars for depending on libraries to obtain the materials they need, rather than for purchasing them for personal use. So long as this preference prevails, provision will have to be made for reproducing and distributing materials for research in the small editions that the market can absorb, if material essential to the progress of research is to be made available for the use of scholars.

For most publications of this kind, subsidies will in any case be necessary,

FIGURE XXX

and loss of keystrokes at the uneven right-hand margin). Then NK/CP is the number of keystrokes per column.

The formula for making NK/CP keystrokes on a reduced size (or enlarged size) photo-offset column of given dimensions L x W inches can be worked out for any typewriter.

Let A be the number of keystrokes per inch laid down by the typewriter (so that with a pica machine, A equals 10; with an elite machine, A equals 12; with a micro-elite machine, A equals 14; with a "nine-pitch" machine, A equals 9); and let B stand for the number of lines to the inch (which with ordinary single spacing is six, with double spacing is three, and with special spacings may be four, four and one-half, five, and five and one-half).

Given chosen values for A and B, it remains to find W' and L', the width and length of the original typescript copy of a column from which the photo-offset page is to be photographically copied, in a reduction ratio or enlargement ratio which will have the value R.

It is known that $\frac{W}{L} = \frac{W'}{L'}$; and

$AW' \times BL' = \frac{NK}{CP}$. $L' = \frac{NKL}{CPABW}$; $W' = \frac{NKW}{CPABL}$;

therefore, $\frac{L}{L'} = \frac{W}{W'} = R$.

The composition costs of typescript books, it has been proved, are highly variable; the principal levels for a book of 50,000 words are determined by the five situations shown in Table XXIII.

To simplify cost calculations, composition cost will be taken for the third situation only--i.e., for typing done by a typing bureau at an average price. The typescript composition cost for photo-offset will therefore stand at $62.50 for 50,000 words. Although the differences in format will react upon this composition cost in some measure, this influence will be ignored. Substracting, then, the composition cost from the two total sums suggested as alternatives (i.e., price of a mimeographed and price of a printed book), the following amounts remain for the production of a photo-offset book, exclusive of typing:

Photo-offset price to equal
mimeographing $158.00
less composition cost 62.50
leaves .... 95.50 for
photo-offset metal sheets and press work.

Photo-offset price to equal
printing $365.00
less composition cost 62.50
leaves .... 302.50 for
photo-offset metal sheets and press work.

TABLE XXIII

COMPOSITION COST OF MAKING A FORMAT COPY FOR A BOOK OF 50,000 WORDS OF STRAIGHT TEXTUAL MATTER UNDER VARYING CONDITIONS OF COST DISTRIBUTION

1. When the author provides the format copy, not charging the composition cost to the manufacture of the book	$ .00
2. When format copying is done as part of an office expense, and figured into the cost of manufacture in the form of wages	$50.00
3. When format copying is charged at typing bureau estimates and figured into the manufacturing of the book (interpolated from quotations)	$62.50
4. When format copying is charged by shop in connection with manufacturing job quotation (composite quotation)	$75.00
5. When format copying includes cost of justifying the right-hand margin (interpolated from quotations)	$100.00

In Chapter III area costs of photo-offset work are found. These indicate that the sums listed above will purchase the following amounts of page area in a photo-offset edition of 500 copies:

For $95.50 can be bought 500 copies of twenty-eight pages, 8 1/2" x 11", which will require 1786 words to a page to reproduce 50,000 words; or, $95.50 will buy 500 copies of forty-four pages, 6" x 9 1/2" (twenty-two printings from a metal sheet 9 1/2" x 12"), which will require 1136 words per page to reproduce 50,000 words.

How can the typescript copy be prepared to lay this number of words on a page in a format satisfactory for photo-offset in these sizes of metal sheet or paper?

The arrangement of 6" x 9 1/2", less 1/2" margin on top, bottom and outside, and with a 3/4" margin on the bound edge, can be made in this manner: two columns, each column 8 1/2" high, carrying 568 words, in column width not greater than 2 1/8", leaving 1/2" between columns. Such a column will roughly resemble newsprint in width. Counting 6 keystrokes per word to allow for spacing and loss on the right-hand margin, the number of keystrokes must be 3408 in a column 8 1/2" x 2 1/8". An interlinear spacing of five lines to the inch with pica type would be used.

In full pica size, 8 1/2" will be filled with forty-two lines at five lines to the inch, and 2 1/8" with 21 keystrokes; at full size, therefore, this area will accept 882 keystrokes. But since it must accept 3408 keystrokes in reduced size, the reduction must be such that four times this number of keystrokes will go on this area. The square root of four is two. The pica typescript must, therefore, stand at a reduction of two diameters. Since 42 keystrokes reduced two diameters will fill the 2 1/8" column, the typewriter should be set to make columns of this width (42 keystrokes, or 4.2") and carried to a column length of 17". When this is reduced photographically, it is a reduction of approximately 50%. (Figure XXXI.)

In the 8 1/2" x 11" size of page the necessary 1786 words would probably best be set in three columns. Making margin allowances of 3/4" inside margin, 1/2" between columns and for outer margin, and 1" on the top and bottom, the effective width of the columns would be 2.08" and the height would be 9". Each column would be required to take 595 words, or 3570 keystrokes. A reduction ratio of 50% will be necessary. Pica typescript reduced to 50% of original size will suffice in this format. In the format copying, the typist should make each line 43 keystrokes long (4.3") and the column should be typed to 18" in height. (Figure XXXII.)

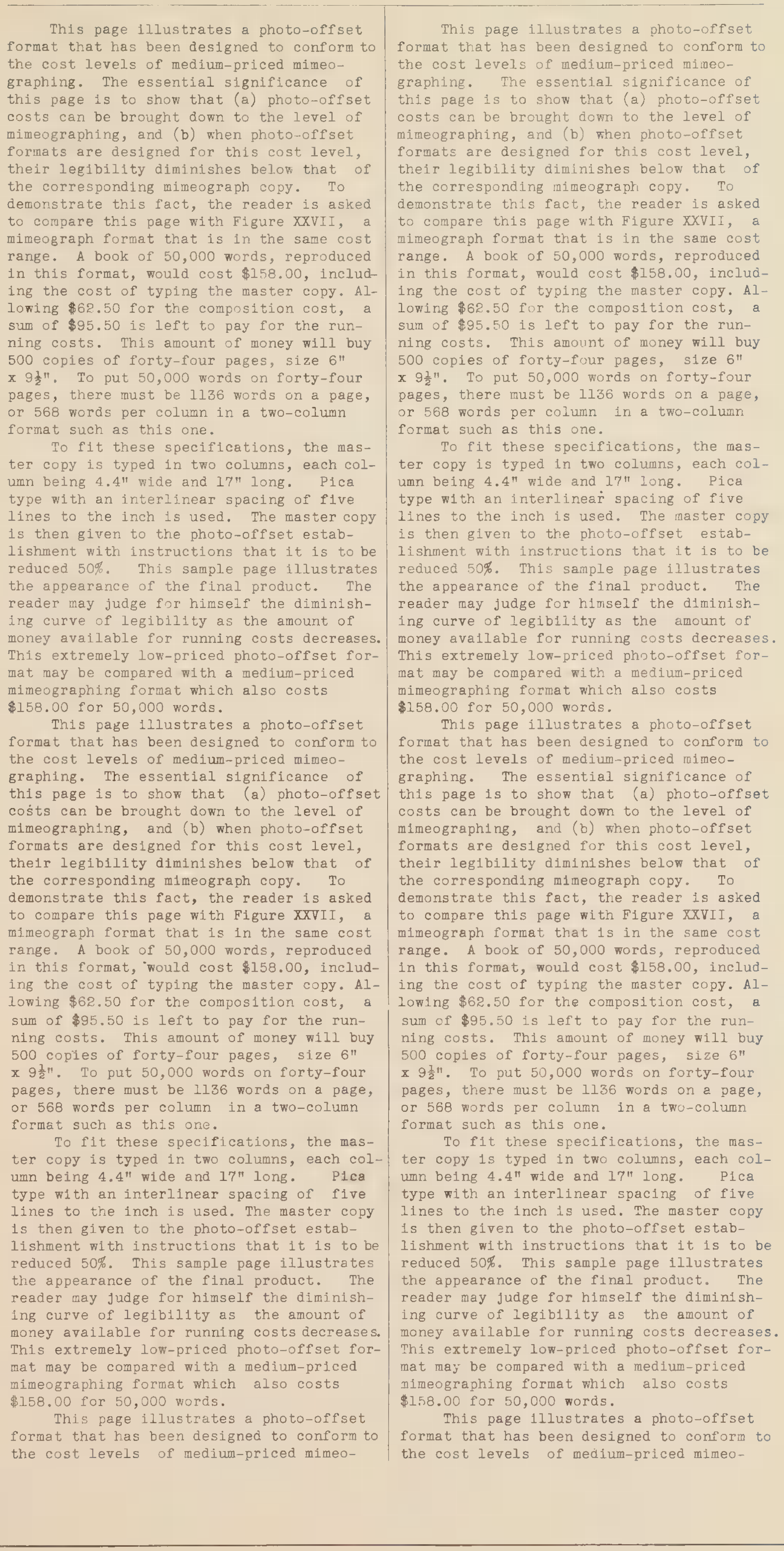
Thus it appears that there are at least two formats in which a photo-offset copy of a 50,000-word text could be made for a price equivalent to the cost of a mimeograph copy. The choice of an 8 1/2" x 11" format would involve reduction of pica typescript by 50%; the choice of the 6" x 9 1/2" format would also mean a reduction of 50%. The typescript format copy for the 6" x 9 1/2" page could be prepared on a typewriter with a 12"-carriage (two columns, each column 4.2", with 1/2" margin between them); the format copy for the 8 1/2" x 11" page would call for a typewriter carriage that would make three columns, each 4.3", with two internal margins of 1/2", and hence a 15"-carriage would be necessary. Of course the typing could be done one column at a time on the typewriter, and the columns then mounted together to make the format copy.

The essential significance of this whole demonstration is, first, that photo-offset formats can be designed to bring photo-offset costs down to the level of mimeographing; and second, that when formats are so designed to bring the photo-offset costs to this level, the legibility diminishes below that of the corresponding mimeograph copy. Pica typescript reductions of 50% are close to the lower limit of legibility without a reading glass.

If the composition cost is set at a lower level by basing it upon a wage rate in an office, the number of 8 1/2" x 11" pages upon which the 50,000 words would be spread would be increased from twenty-eight to thirty-two, because there would be more money left over from typescript composition to pay for the photo-offset work. It would then be necessary to put only 1560 words on a page instead of 1786, only 520 words in a column instead of 595. This could be accomplished by reducing the typescript only 47%, to 53% of its full size.

It often happens that a manuscript is submitted to a photo-offset shop and a

FIGURE XXXI



This page illustrates a photo-offset format that has been designed to conform to the cost levels of medium-priced mimeographing. The essential significance of this page is to show that (a) photo-offset costs can be brought down to the level of mimeographing, and (b) when photo-offset formats are designed for this cost level, their legibility diminishes below that of the corresponding mimeograph copy. To demonstrate this fact, the reader is asked to compare this page with Figure XXVII, a mimeograph format that is in the same cost range. A book of 50,000 words, reproduced in this format, would cost $158.00, including the cost of typing the master copy. Allowing $62.50 for the composition cost, a sum of $95.50 is left to pay for the running costs. This amount of money will buy 500 copies of forty-four pages, size 6" x 9½". To put 50,000 words on forty-four pages, there must be 1136 words on a page, or 568 words per column in a two-column format such as this one.

To fit these specifications, the master copy is typed in two columns, each column being 4.4" wide and 17" long. Pica type with an interlinear spacing of five lines to the inch is used. The master copy is then given to the photo-offset establishment with instructions that it is to be reduced 50%. This sample page illustrates the appearance of the final product. The reader may judge for himself the diminishing curve of legibility as the amount of money available for running costs decreases. This extremely low-priced photo-offset format may be compared with a medium-priced mimeographing format which also costs $158.00 for 50,000 words.

This page illustrates a photo-offset format that has been designed to conform to the cost levels of medium-priced mimeographing. The essential significance of this page is to show that (a) photo-offset costs can be brought down to the level of mimeographing, and (b) when photo-offset formats are designed for this cost level, their legibility diminishes below that of the corresponding mimeograph copy. To demonstrate this fact, the reader is asked to compare this page with Figure XXVII, a mimeograph format that is in the same cost range. A book of 50,000 words, reproduced in this format, would cost $158.00, including the cost of typing the master copy. Allowing $62.50 for the composition cost, a sum of $95.50 is left to pay for the running costs. This amount of money will buy 500 copies of forty-four pages, size 6" x 9½". To put 50,000 words on forty-four pages, there must be 1136 words on a page, or 568 words per column in a two-column format such as this one.

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FIGURE XXXII

This photo-offset format is designed to accommodate 1768 words to the page. To reproduce a book of 50,000 words by photo-offset at the same cost level as that of mimeographing, this three-column photo-offset format can be used, putting 595 words in each column; or the format illustrated in Figure XXXI can be followed, using a two-column arrangement on a 6" x 9½" page. Both pages, of course, by attempting to approximate the cost range of the Mimeograph approach very close to the lower limits of legibility. The $158.00 that is necessary either for the mimeographing of 50,000 words or for the photo-offsetting of 50,000 words in this format, is probably best used for the mimeograph.

Using Hoch's figures, as given in Chapter III, it is found that $95.50 will buy twenty-eight pages of size 8½" x 11". This means the putting of 1768 words on a page to accommodate the 50,000 words of the manuscript. The reader may judge for himself the difference in legibility between this format, the format illustrated in Figure XXXI, and the mimeograph format of Figure XXVII.

Again, as has been explained in the text, it is possible to give a larger proportion of the $158.00 to the running costs by either doing the typing personally and not counting the cost in, or by having it done by cheap labor. However, it is quite possible that the typing would be of such inferior quality that the amount saved for running costs would be much better spent for composition.

This format again illustrates the saving that is made possible by the use of a special spacer. Five lines to the inch is used for this format, instead of the usual six lines to the inch (regular single spacing) which is too crowded for good legibility, or the three lines to the inch (regular double spacing) which is too widespread to be economical.

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FIGURE XXXIII

This photo-offset page is made up in a format that costs the same to reproduce as an economical print format. The $365.00 that would be required to print 50,000 words is here devoted to making a photo-offset reproduction from typescript. $62.50 of it is allotted to the composition cost, leaving $302.50 to pay for the running costs. This amount will buy 500 copies of sixty-nine pages, 9½" x 12", or, as with this format, 138 pages, 6" x 9½". With the larger size page, only 725 words need be put on each page; with this 6" x 9½" page, only 363 words need be put on each page.

Leaving wide margins and typing in a single column with four-lines-to-the-inch spacing, a reduction of 33% takes care of the word content. The resulting page is a very legible and very expensive way of putting the photo-offset process into use.

If it should happen that the format copy were then sent to a photo-offset printer for quotation who was using a press with a 17" x 22" metal sheet, his quotation for the job would be substantially higher than the figure of $302.50 that is the basis of this calculation, because he would have to run the whole printing surface to get four pages of 6" x 9½", and the wastage of his metal sheet printing surface would be almost 40%. This fact is brought into the picture to emphasize the importance of considering, in the planning of a format, not only the arrangement of typescript columns that will lay the required number of words on a page, but also the relation of the page size chosen to the dimensions of the metal sheet of the press upon which it is to be run.

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WAGES EXPENSE

1935						1935					
Dec.	31	Balance		10,000	00	Dec.	31	To P. & L.	J74	10,250	00
	31	Accrued	J72	250	00						
				10,250	00					10,250	00
						1936					
						Jan.	1	Accrued	J 1	250	00

Assume that on pay day, January 4, $440.00 is paid to workmen. This payment would represent the discharge of a wage liability of $250.00 already on the books (the credit balance in the Wages Expense account), and the payment of $190.00 labor expense of the new period. The entire $440.00 should be charged to the Wages Expense account:

WAGES EXPENSE

1936						1936					
Jan.	4	....	CP1	440	00	Jan.	1	Accrued	J 1	250	00

The balance of the account, $190.00, is the correct wage expense for the new period.

Other examples of accrued expenses are advertising, commissions, interest, salaries, workmen's compensation insurance; also the utility services, gas, electricity, and water.

Adjusting entries for accrued expenses are necessary, for, without such adjustments:

- the expenses of the period will be understated,
- the net income overstated, and
- the balance sheet will be incorrect because of the omission of accrued expenses from its liability side.

DEFERRED INCOME

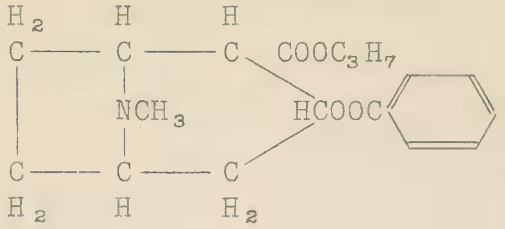
Some incomes may be recorded on the books before they are earned. Suppose for instance, that an insurance company credits Insurance Income for an initial annual premium of $2,400.00, which it receives on December 1, from a new policy holder. When the books are closed December 31, it would not be correct to consider all of the $2,400.00 as income earned in the period ending that date. This is because the insurance protection is rendered not for one month but for twelve months. It follows that since 1/12 of the insurance protection is rendered during December, 1/12 of the income, or $200.00, should be credited to that month. The remaining 11/12ths, or $2,200.00, should be credited to the income of the new year.

A statement of principle may therefore be made: income which has been recorded on the books but which is, in whole, or in part, unearned income at the end of an accounting period, should be removed from the income account of the current period and carried forward to the next period as unearned, or deferred, income. The accounting entries are as follows:

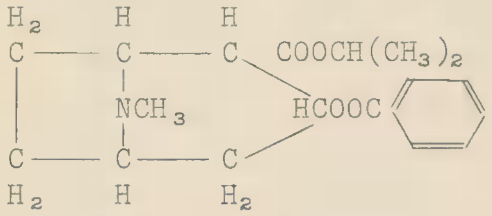
Income accounts are debited with the amount to be deferred, and the credits are made either to separate liability accounts,--one account for each type of deferred income,--or to one summary account called Deferred Income. The latter method is ordinarily to be preferred. Unless further other adjustments are necessary, the income accounts are closed to Profit and Loss, and the account with Deferred Income is carried to the balance sheet as a liability. It is a liability because it is an obligation which is payable, not in cash, but in services.

FIGURE XXXIV

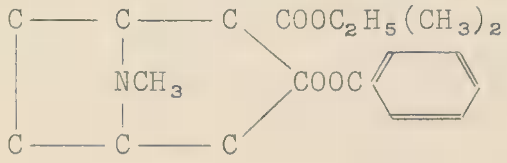
it causes toxic changes of the liver.



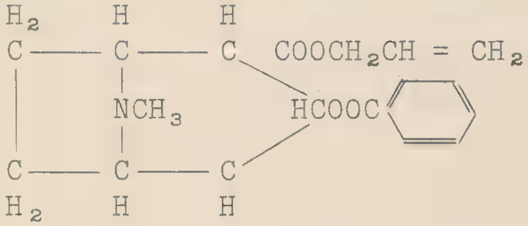
The benzoyl ecgonine iso-propyl ester has, according to His (1894), local anesthetic properties and causes also degenerative changes of the liver (Ehrlich, 1890).



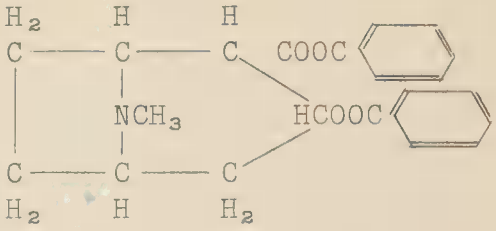
The benzoyl ecgonine iso-butyl ester does not differ materially from cocaine in its local anesthetic and toxic properties (Ehrlich, 1890; His, 1894).



The benzoyl ecgonine allyl ester was prepared by Poulson and Weidemann (1924). The free base melts at 98°C and is nearly insoluble in water but easily soluble in organic solvents; the solutions are levorotatory. The hydrochloride is easily soluble in water. The systemic action and the toxicity are similar to that of cocaine, the local anesthetic action being, however, more marked. This was confirmed in human eyes by Hagen who found that in opposition to cocaine, even solutions of 0.5 per cent cause complete anesthesia. With 5 per cent solutions the effect is also more lasting than with cocaine and the mydriatic action is less marked at the same time. Although it causes a slight primary irritation, no permanent injury of the eye could be observed.

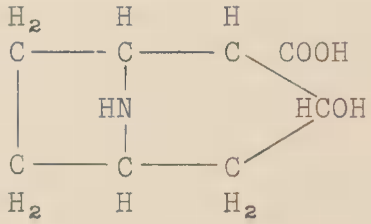


The benzoyl ecgonine benzyl ester was also prepared by Poulson and Weidemann (1924). The hydrochloride forms well-defined crystals which melt at 123°C and which are easily soluble in water and alcohol, the solutions being levorotatory $[\alpha]_D = -18.5^\circ$. With intravenous administration the toxicity is of the same order as that of cocaine. On the rabbit's cornea it was found to be more effective than the latter as to the local anesthetic action, but it causes marked irritation and swelling and for this reason is of no clinical value.



Chemical changes around the nitrogen atom of the ecgonine molecule have led to the following compounds:

Nor-ecgonine has, like ecgonine, no local anesthetic action (His, 1894) and also causes no degenerative changes of the liver.



The benzoyl ester, benzoyl-nor-ecgonine, has no local anesthetic action (Poulson, 1890; His, 1894) and causes no characteristic degenerative changes of the liver. According to Poulson the systemic action in frogs differs from that of cocaine in that the subcutaneous

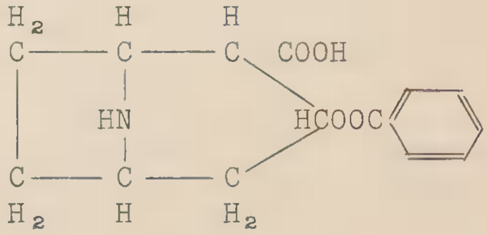


FIGURE XXXV

printing shop for quotations, and that the quotations for a printed product are about the same as those for a photo-offset book from typescript. This is invariably the result of the choice of format for the photo-offset book. The printing prices, as has been proved in Chapter III above, cannot respond as actively to change in format as the photo-offset prices. To ask "is photo-offset as expensive as printing?" is to avoid the essential element in photo-offset pricing, namely area cost and reduction ratio of the typescript. By calculations corresponding to those used above, it is easy to determine a format in which a typescript book, reproduced in 500 copies by photo-offset, will cost as much as the same book reproduced in print.

If the $365 that would be required to print 50,000 words is devoted to making a photo-offset reproduction from typescript, $62.50 of it must be allotted to typescript composition, leaving $302.50 to pay for the photo-offset work itself. This will pay for 500 copies of 69 pages, 9 1/2" x 12", or 138 pages, 6" x 9 1/2". It would be necessary to put no more than 725 words on each 9 1/2" x 12" page, or 368 words on each 6" x 9 1/2" page. Leaving wide margins and typing in a single column with five-lines-to-the-inch spacing, a reduction of 24%, to 76% of full size, would take care of the 9 1/2" x 12" page. The typist would simply set the stops to write 85 keystrokes to a line (8.56"), type 60 lines on a page, and ask the photo-offset printer to reduce the page to 76% of full size. On the 6" x 9 1/2" page, the typist would set the stops to write 54 to 55 keystrokes, type 47 lines at four-lines-to-the-inch spacing, and ask the printer to reduce it 33% to 67% of full size. (See Figure XXXIII.) The resulting pages would be very neat, very legible, and a very expensive way of using the photo-offset process.

If it should happen that the format copy were then sent for quotation to a photo-offset printer who was using a press with a 17" x 22" metal sheet, his quotation for the job would be substantially higher than the figure of $302.50 that is the basis of this calculation, because he would have to run the whole 17" x 22" to get four pages 6" x 9 1/2", and the wastage of his metal sheet printing surface would be almost 40%. This fact is brought into the picture to emphasize the importance of considering, in the planning of a format, not only the arrangement of typescript columns that will lay the required number of words on a page, but also the relation of the page size chosen to the dimensions of the metal sheet of the press upon which it is to be run.

In the first edition of this manual, the writer gathered quotations on the manufacture of photo-offset typescript books and fitted them to a chart in which they were compared to the manufacturing prices of printed books. It has become evident, as a result of further study, that this way of presenting the comparison is completely misleading because it ignores the vital factor of format. Therefore, in this analysis of the use of photo-offset to reproduce typescript, several formats are designed, and the manufacturing prices of a book in each format are calculated. These prices are sufficiently checked with actual quotations to make them indicative of the general price levels at which photo-offset can be used. (See Figures XXXIV and XXXV.)

Photo-Offset from Normal Fair Copy, without Additional Format Typing

It will often happen that a fair copy of a manuscript has been made in the ordinary typescript format, 300 words to the page. This question then arises: shall the text be retyped as a special format copy for photo-offset reproduction, or shall the fair copy be used as a format copy? This is a special case of the problem of controlling typescript composition costs by merging fair and format typing operations. It can now be given a specific answer.

A manuscript of 50,000 words, typed in the normal 300-word format, fills 166 pages. To retype this manuscript in a special format for photo-offset reproduction would cost $62.50. Now this $62.50, if diverted from the payment of composition cost to the payment of area cost, will buy nineteen extra pages, 8 1/2" x 11", or 28 extra pages, 6" x 9 1/2", in an edition of 500. If this $62.50, instead of going to composition, is actually paid to the offset printer, the text can be spread over this additional amount of page area without changing the total cost of the edition. The additional page area released to the photo-offset by an elimination of the retyping process is the same, regardless of the total amount spent for the publication. Whether the book is to be published for $158.00 or for $365.00, it will still be true that the money diverted from composition cost will buy exactly the same amount of additional photo-offset surface.

Will it pay to make this diversion? Will retyping so greatly increase the efficiency in the use of photo-offset page area as to justify reducing the number of available pages upon which the text is to be reproduced? This special case of the fair copy-format copy problem is particularly important, because the 300-word format is the normal one in which typescripts are prepared, and in which they are presented to editors or bound as typescript dissertations.

It has been shown above that the 50,000 word text can be retyped and reproduced in a 6" x 9 1/2" or an 8 1/2" x 11" book for $158.00 (the same price as mimeographing) by reducing the pica typescript to 50% of full size.

If the entire $158.00 is spent for photo-offset work, it will buy six full sheets 22" x 34" ($153.66). These six sheets will divide into 168 pages of 5 1/2" x 4 6/7". This particular way of folding the sheet will cause an additional expense in gathering, but the extra expense will probably not exceed the difference between $153.66 and $158.00. The normal typescript pages, reduced to go on pages of this size, must pass through a reduction of 45%, leaving them 55% of full size. The page would then have a 1/2" margin top and bottom, and side margins of nearly an inch. This reduction ratio would be the same if the typescript pages were reduced to go on pages 5 1/2" x 4 1/4", made by folding 8 1/2" x 11" sheets into four, and costing, for the edition, $133.40. The difference between $133.40 and $153.66 would be an unnecessary expense for needless width of side margins. The alternatives in the "near-print" reproduction of a fair copy of normal typescript are therefore:

1. To retype and mimeograph ($158.00)
2. To photo-offset without retyping, reducing to 55% of full size ($133.40)
3. To retype and photo-offset, reducing to 50% of full size ($158.00).

Another standard price level is suggested by the dimensions and word count of the normal typescript page, because of the importance of utilizing the full area of the photo-offset metal sheet. This is the size 8 1/2" x 5 1/2", obtained by reducing a full page of typescript to a half page of photo-offset. Metal sheets that will take an 8 1/2" x 11" page without wastage will also take the 8 1/2" x 5 1/2" without wastage. If top and bottom margins of 3/4" are left on the photo-offset page, the reduction of the typescript will be 23%, to 77% of full size, and the cost of the edition of 500 will be $265.00. This is a price level at which the innumerable bound theses that fill the shelves of graduate schools could be brought conveniently into print without retyping.

If the sum of $265.00 is to be spent to reproduce typescript in a retyped format, it can be made to yield a two-column page 8 1/2" x 11", with each column 3.6" wide, and 1/2" margins top and bottom, in exactly the same reduction, namely 23%.

Therefore the cost of reproducing a typescript by photo-offset in a reduction of 23% would be the same, whether or not the additional format typing were done.[4] The saving of page area involved in shifting from one column to two, and from normal double spacing to special spacing four and one-half-to-the-inch, and from the 3/4" to the 1/2" top and bottom margin, would exactly pay the cost of the format typing.

These figures make possible an interesting comparison with the actual price quotations offered by Edwards Brothers. Edwards Brothers offer to type and manufacture an edition of 500 copies of 50,000 words for $265.00. The calculations above and the format designed above to bring a retyped book to the same price of manufacture as a book reproduced directly from a normal fair copy of 8 1/2" x 5 1/2" photo-offset pages, are based on an average quotation for typing and on the photo-offset shop quotations made by Hoch. The agreement with the Edwards figures seems very near, for it would appear that Edwards

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[4] The typing instructions for preparing this format page are: pica type, special spacing of 4½-to-the-inch, in columns 4.8" (or 48 letters) wide, and 13" (or 68 lines) long.

Brothers would also find a point where the economies of a compressed format on a page would make up for the extra cost of a format typing. The reduction in both cases is not far from 25% (30%, 23%).

The prices charged by Edwards Brothers have been widely published in two pamphlets: *Junior Models for Lithoprinting*, and *Manual of Lithoprinting*. These quotations are listed herewith: the figures for price of edition and price per page have been calculated by the author from the Edwards figures.

TABLE XXIV

PHOTO-OFFSET PRICES

(For 8 1/2" x 5 1/2" page, format 350-J, 350 words per page, quoted in units of 57 pages, or 20,000 words, including cheap binding)

Composition Cost Included Edwards Type (area plus composition)				Composition Cost Excluded Author Type (area cost)			
No. of Copies	Price Each	Price per Page in This Edition	Price of Whole Edition	No. of Copies	Price Each	Price per Page in This Edition	Price of Whole Edition
100	$.75	$1.31	$75.00	100	$.57	$1.00	$57.00
250	.39	1.71	97.50	250	.32	1.40	80.00
500	.26½	2.32	132.50	500	.23	2.02	115.00

The difference between the "Edwards type" and the "author type" figures for 20,000 words is $18.00; the price of the typing is therefore to be reckoned at $.90 per 1000 words in this format.

(For 8 1/2" x 11" page, format 700-D, 700 words per page, quoted in units of 72 pages, 50,000 words, including cheap binding)

Composition Cost Included Edwards Type (area plus composition)				Composition Cost Excluded Author Type (area cost)			
No. of Copies	Price Each	Price per Page in This Edition	Price of Whole Edition	No. of Copies	Price Each	Price per Page in This Edition	Price of Whole Edition
100	$1.57	$2.18	$157.00	100	$1.18	$1.64	$118.00
250	.79	2.74	197.50	250	.64	2.22	160.00
500	.53	3.68	265.00	500	.45	3.12	225.00

The difference between the "Edwards type" and the "author type" figures for 50,000 words is $39.00; the price of the typing is therefore to be reckoned at $.78 per 1000 words in this format.

The Edwards' model 700-D requires seventy-two pages for the 50,000 words; the Edwards' quotations for typing in this format are $.78 per 1000 words instead of the $1.25 which is the average figure. The composition cost is figured at $39.00 for the 700-D model with 50,000 words. The price of an edition of 500 copies typed by the author is $225.00; the price of an edition typed at the shop is about $39.00 more (or $264.00). Edwards quotes $265.00 for the shop-typed copy.

There are other contrasts to be examined. The Hoch quotations for 500 copies of a page 8 1/2" x 11" stand at $3.20; Edwards prints this amount of matter, collates, and includes a cheap binding for $3.68. But the Hoch quotations show a constant proportionate relationship between the prices of full metal sheets and half sheets. If Edwards Brothers sets up the 8 1/2" x 11" area in the form of two pages, 8 1/2" x 5 1/2", the price is equivalent to $3.92 instead of Hoch's $3.20. Of course the collating and binding cost counts for something in this comparison, but the figures reveal nonetheless a certain elasticity in costs per square inch of page (area costs) and in running cost behavior.

The buyer of photo-offset service can conclude from these illustrations that it is wise to secure quotations separated into the three parts:

1. Area costs (page area chosen to fit metal sheets)
2. Running costs (quoted as a constant figure per additional hundreds of copies)
3. Typing costs (quoted in thousands of words, or in pages of a specific format)

With these quotations in hand, he can divide the work and plan his format to produce maximum legibility at minimum cost.

Typing Instructions

Since these tables reveal a considerable difference in costs and prices dependent upon the character of a composition cost, instructions for the preparation of a format copy for the photo-offset typescript book are properly a part of this chapter.

Since the typescript copy must be a photographic object it should be as black as possible. Some companies recommend the use of a special bronze ribbon; in all cases the ribbon should be fresh and black. To avoid an uneveness in the impression produced by the fabric of the typewriter ribbon a special silk ribbon or one made of carbon paper may be used. The typewriter type must be perfectly clean and the touch of the typist even; the Electromatic typewriter may be used to great advantage here.

Format instructions as to line length, interlinear spacing, etc., are most easily followed out if paper with a printed margin line can be provided, clearly designating the typing area. Photo-offset printers often provide such sheets. With paper so marked, and with the right ratchet and ribbon on the typewriter, and the right paper on the roller, any standard typewriter and any normally efficient typist should be able to turn out superior work.

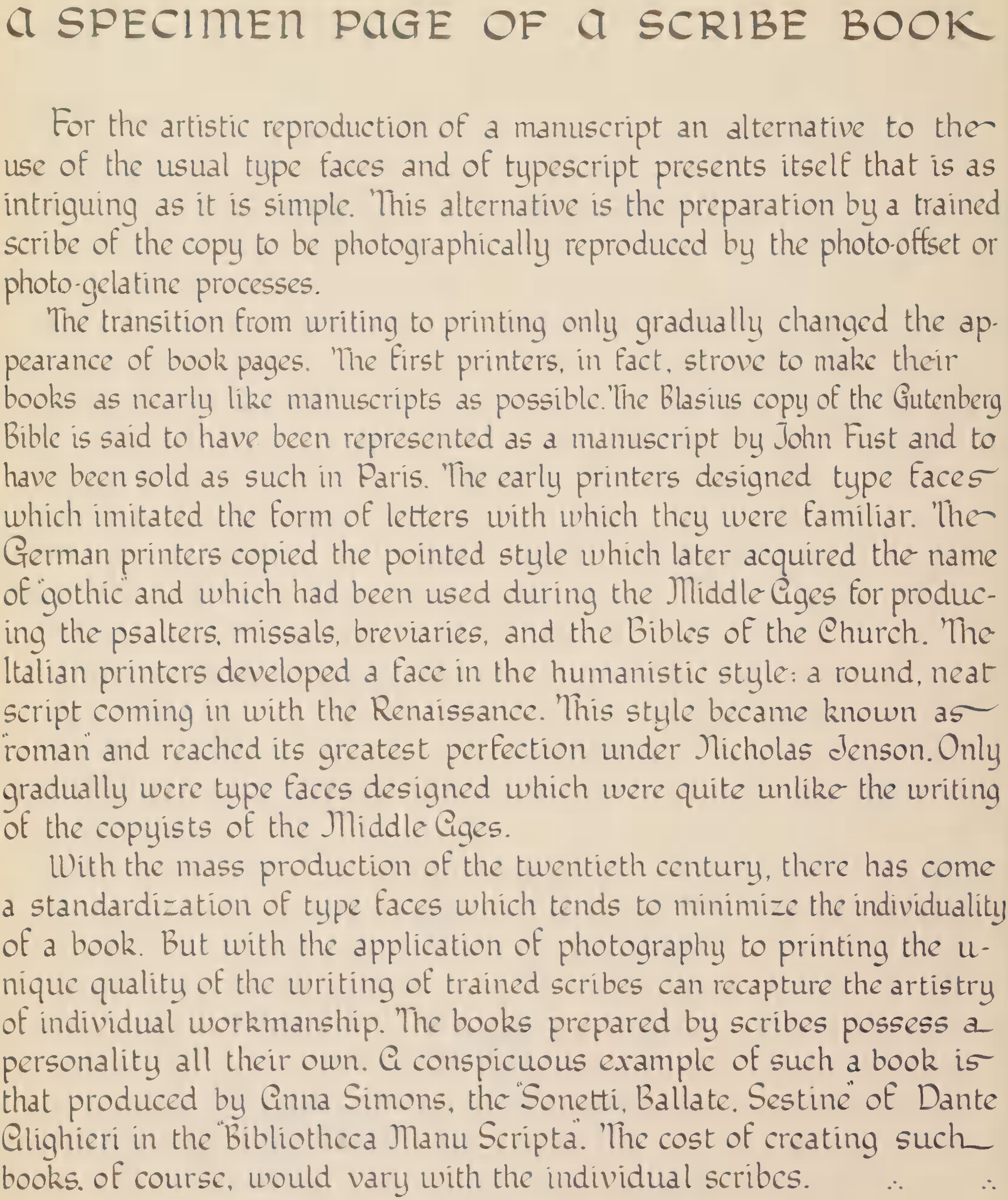
There are two ways of preparing typescript for the two-column page. The copy can be typed directly on a large sheet marked off into two columns or upon a long one-column galley, to be cut and fastened on the two-column page backing with rubber cement. The former is perhaps the better method in handling copy which is absolutely "straight"--no footnotes, no illustrations, no probability of author's revisions. But if the design of the page requires so many letters per column that the two columns cannot be typed together on the normal 10"-carriage, or if there is a prospect of many corrections or of footnote material to be fitted in place, the galley strip method of typing is probably superior.

All corrections may be made with shears and rubber cement. The new matter may be placed on top of the old, or else the deleted matter may be cut out and the new matter pasted in its place.

Paste pot and shears will also serve to make page proofs of galley proofs. The paper for the page proof should have a strong line running down the middle if the final copy is to show the two columns divided by a line. Diagrams, photographs, and other non-typescript matter can be fitted into the pages at this stage in the preparatory process.

V. The Manuscript Book

Our habits of judgment have been so formed that we always expect to see certain kinds of thought going around in their



A SPECIMEN PAGE OF A SCRIBE BOOK

For the artistic reproduction of a manuscript an alternative to the use of the usual type faces and of typescript presents itself that is as intriguing as it is simple. This alternative is the preparation by a trained scribe of the copy to be photographically reproduced by the photo-offset or photo-gelatine processes.

The transition from writing to printing only gradually changed the appearance of book pages. The first printers, in fact, strove to make their books as nearly like manuscripts as possible. The Blasius copy of the Gutenberg Bible is said to have been represented as a manuscript by John Fust and to have been sold as such in Paris. The early printers designed type faces which imitated the form of letters with which they were familiar. The German printers copied the pointed style which later acquired the name of "gothic" and which had been used during the Middle Ages for producing the psalters, missals, breviaries, and the Bibles of the Church. The Italian printers developed a face in the humanistic style: a round, neat script coming in with the Renaissance. This style became known as "roman" and reached its greatest perfection under Nicholas Jenson. Only gradually were type faces designed which were quite unlike the writing of the copyists of the Middle Ages.

With the mass production of the twentieth century, there has come a standardization of type faces which tends to minimize the individuality of a book. But with the application of photography to printing the unique quality of the writing of trained scribes can recapture the artistry of individual workmanship. The books prepared by scribes possess a personality all their own. A conspicuous example of such a book is that produced by Anna Simons, the "Sonetti, Ballate, Sestine" of Dante Alighieri in the "Bibliotheca Manu Scripta". The cost of creating such books, of course, would vary with the individual scribes. ∴ ∴

FIGURE XXXVI

working clothes; others we expect to see parading in formal dress. Typescript and newsprint are the clothes that thought wears in its daily work; the typography of book manufacture is its more formal attire. But the formal dress that thought acquires in book typography is only a ready-made suit after all: calligraphy offers to clothe thought in much richer and more beautiful tailor-made attire, which should have a higher prestige value than book typography.

The beauty of the manuscript has been increasingly appreciated as the centuries have confirmed the triumph of letterpress. Precisely the same qualities that make printing more attractive than typescript would tend to make manuscript more attractive than printing. There is more chance for close adaptation of letter form to the spirit of the text, more chance for creative artistry.

The twentieth century has already developed its scribes. The influence of Edward Johnston, author of the foremost general book on illuminating and lettering in English,[5] has been felt not only in the beautification of typographical design but also in the growth, especially on the Continent, of a school of artists in whose work calligraphy meets creative literature, pictorial, art and bookbinding in a product which adapts medieval craft to modern design.

The handwritten book, as made by a penman like Rudolf Spemann, is, however, a rarity; its costs are high and its editions small, with the result that the average person seldom sees and never possesses a manuscript book.

But now a new prospect opens: the manuscript can come back in current publishing; the graphic arts are prepared to make it available to the common man. Photo-offset will multiply any black on white format copy, whether prepared by relief printing, typewriting or calligraphy. The inexpensive photo-offset press may make possible a production of manuscript books as a special small-scale craft; the art of the scribe can now return, relieved from the rule of constant costs which placed it at such a disadvantage in competing with diminishing costs of the printing craft. The illustration on the preceding page serves to show what might be done in this line. (Figure XXXVI.)

Cost Analysis: Composition Costs

The area and running costs of a manuscript book reproduced by photo-offset do not differ from those of any other kind of book reproduced by this technique. The difference comes in composition costs, which naturally are high as compared with those of typescript and linotype work. There are no set prices for handwritten master copy, but an estimate of 1200 words per day at $3.00 or thirty pages a week for $20.00 was made for the Joint Committee.

These prices would naturally be prohibitive for the 50,000-word book chosen as a standard for the other pages in this chapter. They would be reasonable, however, for the reproduction of current literature --say, a small volume of poetry. The reproduction of current literature in this form might have an interesting effect upon culture, for it might help to implement cultural decentralization away from the great metropolitan centers. It would have little bearing, however, upon the problem of reproducing research materials except as it would help to deprive book typography of its privileged place as an arbiter of intellectual quality.

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[5] E. Johnston, Writing and Illuminating (14th ed., London and New York, 1925).

CHAPTER VI

BLUEPRINTING, PHOTOSTATING, AND ALLIED TECHNIQUES

Van Dyke and Lithoprint (First Costs High; Running Costs Low)

A number of techniques have been developed for the copying of architects' drawings, maps, and other non-textual material, but adapted to certain problems in the reproduction of texts. In these copying techniques it is a question of decisive importance whether the original from which the copy is to be made is a positive or negative, and whether the copies are desired in positive or negative form.

There are two processes resembling the photolithographic and photogelatin processes, but adapted to the reproduction of large black-on-white drawings or maps. The first is the reversing positive or Van Dyke process. It sometimes happens that there will be some advantage in making a photo-offset metal sheet directly from a black-on-white original. This is especially likely to be useful in the reproduction of maps. A British army engineer by the name of Van Dyke devised a method for preparing a metal sheet without a photographic negative of the master copy.

The process is first to coat the metal sheet with bichromated fish glue and then to make a photographic print on it from an original tracing or photopositive instead of a negative. The glue is hardened, not on the lines and letters, but around them. On the lines and letters the metal is cleaned bare. If such a sheet were put directly on the press it would print a black background, leaving the letters white, for the bare metal would accept water and the glue would accept ink.

But the printing quality of the surface can be reversed by an ingenious device. First, the whole surface is covered with ink, no part of it being moistened with water. The bare metal, unprotected by moisture, takes as much ink as the hardened glue. If the sheet were used in that state, it would cover the whole paper solid black.

Then comes the reversing step. Some of the ink is sticking directly to the metal; the rest is held to the metal only by the film of glue. If the glue is eaten away, the ink will fall off. An acid bath will attack the glue without touching the ink that has adhered directly to the metal. The metal sheet is immersed in acid, and when the acid has done its work the hardened glue falls off, bearing the ink with it. The metal then shows a surface of lines or letters formed in ink with bare metal between them. If this sheet is put on the offset press and the bare metal moistened with water, it will print like any other photolithographic sheet. The inked parts of the metal continue taking ink, the moistened parts continue taking water and rejecting ink.

A process which has been called Ordoverax and is given the name Lithoprint by the Lithoprint Company of New York, Inc., 41 Warren Street, New York City, is the second of these methods. As dermaprint arrives as a gelatin adaptation of the mimeograph, so the Ordoverax process appears as a gelatin adaptation of blueprinting techniques. The process does not seem to have much currency in America except in the books about techniques, but its possibilities are interesting. A gelatin-covered plate is reduced to a gummy condition at a low temperature. An exposed but undeveloped blueprint will transfer its lines to a gelatin surface so that the gelatin surface will become differentially receptive to ink, like a developed photolithographic metal sheet. The same result can be obtained by bringing a gelatin surface into contact with a certain chemical ink. Typewriter ribbons can be impregnated with the active chemical. The process ought to fit very well in the no-man's land of reprinting techniques between five and twenty-five copies. It is curious that the principle has not been developed as an improvement of the hectograph, for the hectograph already uses a gelatin surface. Price data on the process are not easily obtainable, nor are the writers certain of any firm that uses it, although certain blueprint firms claiming to do work by "secret" processes may be using this one.

The Van Dyke process is used principally for map work, the lithoprint method for multiplying drawings upon linen. The costs of both processes act like normal book production costs: there is a large initial cost in preparing the copy and a smaller running cost for the production of additional copies. The Lithoprint Company charges $.06 per square foot in quantities of six copies or over, with a minimum charge of one square foot for each drawing. The purchaser does not get the advantage of declining costs with the increase of edition size beyond six.

A third process, which is known by several trade names, uses a direct-on-tracing-cloth method. It is a process whereby a Van Dyke negative is employed. The Van Dyke negative is placed upon a sensitized tracing cloth, which is exposed to light in a vacuum frame, developed, and washed. From this waterproof tracing cloth, a number of blueprints can be made, and the need for hand tracing is entirely eliminated. Prices for tracing-cloth reproductions start at $.65 per square foot, with reductions in price starting at fifty square feet.

Blueprinting and Photostating (First Costs Low, Running Costs High)

Most of the processes of the blueprint type exhibit a different kind of cost behavior, resembling manuscript costs of the period prior to the invention of printing. The second copy costs almost as much as the first copy; there are very small savings to be obtained by increasing the size of the edition. This situation is normal in all those photographic processes which count upon sensitizing the surface of the paper that is to be used rather than sensitizing the printing surface and then printing with ink on ordinary paper. The machinery for making copies by these processes is always some kind of frame in which the original and the sensitive paper are held in contact and exposed to light. The costs are usually quoted in square feet. The differences are principally differences in the character of the sensitized surface spread on the paper.

There are two ways of transferring an image to sensitized paper: directly, by holding the sensitive surface in contact with the text that is to be copied and forcing the light through it; indirectly, by using a lens, and reflecting light from the text to the sensitized surface. The most common of the direct methods is the blueprint technique, the most common of the indirect methods the photostat. The direct methods always reproduce the original without altering its size; the indirect methods permit enlargement or reduction.

There are four kinds of sensitive surface that are used commonly for making copies "directly" by light transmitted through the master copy (i.e., blueprinting). These are:

1. Ferroprussiate (blueprint)
2. Ferrogallic (indigo black print or gallic print)
3. Sepia, sometimes called Van Dyke
4. Ozalid and BW paper

The ferroprussiate sensitive paper for blueprinting is often manufactured by the blueprinting companies themselves, according to various formulae which yield surfaces of different degrees of sensitivity. It is darkened by exposure to the light and fixed by washing in water. The ferrogallic print is made in the same way, but it is more costly and is not used much in this country. It also has the disadvantage that it is not permanent and that it requires very careful timing of exposure to prevent spoilage. The sepia print surface is sensitized with silver salts and therefore bears a certain chemical resemblance to photostat paper. All these sensitized surfaces are alike in that they will make a white-on-dark copy of a black-on-white object. Ozalid paper is exposed exactly as if it were a blueprint paper; then it is placed in an airtight box in which ammonia fumes are released. The ammonia fumes darken to a dark red the lines on the paper that have not been exposed to light. Therefore a dark-on-white copy can be made at one step from a black-on-white original.

A number of possible manipulations

If now the pressure on the ice-water mixture is reduced to its former value, water will re-freeze to ice, heat will be liberated, and the whole mass will come back up to 0°C. The whole process just described is called regelation, i.e., a re-congealing after a melting under pressure.

If a skater weighing 150 lb. supports his weight on a skate which touches the ice over an area of 0.01 sq. in., the pressure underneath the skate runner will be 1000 atmospheres, and the melting point of the ice will be lowered several degrees. The ice melts beneath the skate and the skater glides along on the wet ice with little friction. As the skate moves off the water, the water re-freezes at the lowered pressure, and the ice is as solid as before.

One theory of glacier flow is that ice melts under pressure, flows around an obstacle in its path, and re-freezes when the pressure is relieved. Snowball making and the cutting of a block of ice by a loaded wire are also illustrations of regelation.

In the case of a loaded wire cutting a block of ice, Fig. [illegible], the ice beneath the wire can melt if heat is supplied. Once the process is started, water below 0°C. is formed underneath the wire; this water flows up past the wire, where the pressure is less and where the water re-freezes; this freezing liberates heat that is conducted through the wire to the ice below; and so the cutting continues.

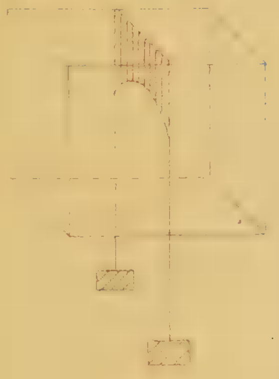


Fig. [illegible]

The above considerations should enable the student to answer the two following oft-asked questions: (a) Will the loaded wire cut through if the whole apparatus is set up in a place where the temperature is very low, say, -10°C.? (b) Will a copper wire, which is a good conductor of heat, cut through at the same rate as an iron wire, which is a poorer conductor?

Substances that expand upon solidifying are few; among them are water, "type metal" used by printers, and the metal bismuth. For substances that contract when they solidify, the student can formulate the statement that connects pressure increase with change of melting point. Among the substances that melt under pressure only at higher temperatures, lead and mercury show a pressure effect of about the same magnitude as that for ice.

226. THE EFFECT OF A DISSOLVED SUBSTANCE ON THE FREEZING POINT.

Ice cream makers learn that putting salt on ice causes a melting of the ice and the formation of a mixture that is much colder than 0°C. The reason for the melting when ice is brought into contact with equally cold salt or brine (salt solution) is evidently to be sought in the interaction of the molecules of the two substances. But if we accept the melting as an observable fact, we can "explain" the lowering of the

are x_a, y_a, $-f$; x_b, y_b, $-f$; x_c, y_c, $-f$ and the direction cosines of La, Lb and Lc are

$$\frac{x_a}{L_a}, \frac{y_a}{L_a}, \frac{-f}{L_a}, \text{ and } \frac{x_b}{L_b}, \frac{y_b}{L_b}, \frac{-f}{L_b}, \text{ and } \frac{x_c}{L_c}, \frac{y_c}{L_c}, \frac{-f}{L_c}$$

Using x and y to designate the unknown photographic plane coordinates of the nadir point v. Then on the space coordinate system being used, the coordinates of v are x, y, -f; the length of Lv is expressed by

$$\sqrt{x^2 + y^2 + f^2}$$

and the direction cosines of Lv are expressed by

$$\frac{x}{\sqrt{x^2 + y^2 + f^2}}; \quad \frac{y}{\sqrt{x^2 + y^2 + f^2}}; \quad \frac{-f}{\sqrt{x^2 + y^2 + f^2}}.$$

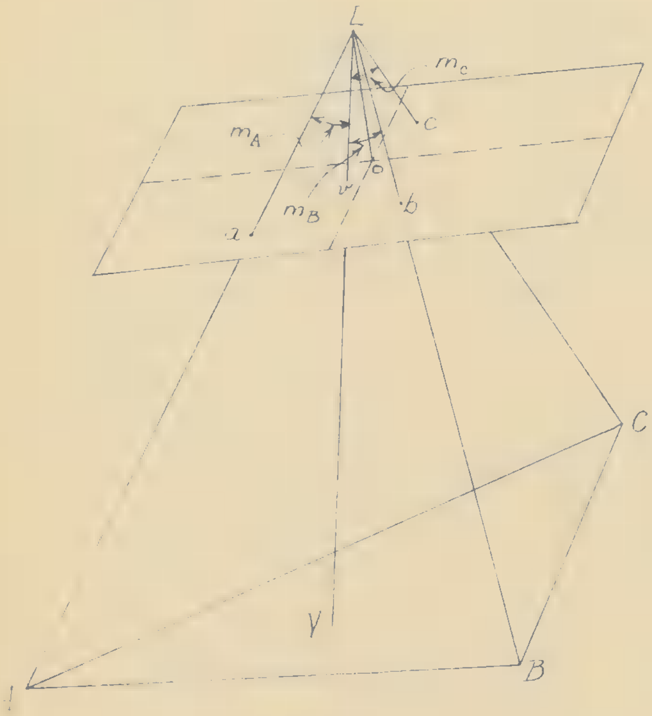


Fig. 72

The unknown angles vLa, vLb and vLc are designated by m_A, m_B, and m_C. By following the usual method of space analytic geometry for finding the angle between two lines, these angles (in terms of the unknown quantities x and y) are expressed by the following relations:

$$\text{Cos } m_A = \frac{x_a x + y_a y + f^2}{La\sqrt{x^2 + y^2 + f^2}}$$

$$\text{Cos } m_b = \frac{x_b x + y_b y + f^2}{Lb\sqrt{x^2 + y^2 + f^2}}$$

$$\text{Cos } m_c = \frac{x_c x + y_c y + f^2}{Lc\sqrt{x^2 + y^2 + f^2}}.$$

Inasmuch as the space coordinat of L, A, B, and C with respect to the su vey axes are all known, it is possib calculate the cosines of the angles between the line LV and each of the lines LB, and LC. See Fig. 72.

If we use L_H to designate the pr jection of L upon a horizontal plane through A, as shown in Fig. 73 the follo ing relations exist:

$$\text{Cos } m_A = \frac{z_L - z_A}{LA}$$

$$\text{Cos } m_B = \frac{z_L - z_B}{LB}$$

$$\text{Cos } m_C = \frac{z_L - z_C}{LC}$$

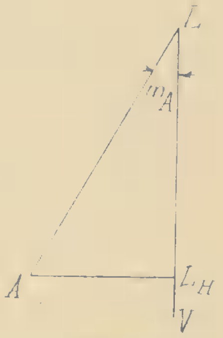


Fig. 73

The final values of LA, LB, and LC have already been calcula ed in the preceding discussion.

To find the plate coordinates x, y of the nadir point v, the problem resolves itself into finding values for the quantities which will satisfy the equation in the preceding column when the known numerical values of the cosines are used therein. These equations constitute thre simultaneous equations with but two unknowns (x and y). Two of these equation could be used to solve for x and y, and i the exposure station has been correctly determined the values obtained will satisfy the third equation. However, the solution would be difficult, for the equations woul be complicated quadratics. A simpler way to find x and y is to combine the equation in the preceding column algebraically to obtain two linear equations. This transformation is as follows:

$$\sqrt{x^2 + y^2 + f^2} = \frac{x_a x + y_a y + f^2}{La \cos m_A}$$

$$\sqrt{x^2 + y^2 + f^2} = \frac{x_b x + y_b y + f^2}{Lb \cos m_B}$$

$$\sqrt{x^2 + y^2 + f^2} = \frac{x_c x + y_c y + f^2}{Lc \cos m_C}.$$

permit a variety of results in copying by one or another of the blueprint techniques. The original copy must always be a strong black-on-white, and the paper or cloth must be reasonably translucent. By making from this original black-on-white a white-on-brown sepia (Van Dyke) copy, and then using the white-on-brown "negative" sepia copy for producing additional blue or sepia (Van Dyke) "positive" prints, the blueprint technician can produce copies that resemble the original in being dark on a white ground. The B-W process is simply a short-cut to this result.

In the terminology of the trade, a "blueprint" is always a print in which white lines appear on a blue ground. The reverse of a blueprint is a "blue line print," in which blue lines appear on a white ground. The B-W process yields a black line on white, and Ozalid gives a deep red line on white. In making a blue line print, it is customary to make first a Van Dyke negative (white lines on dark ground), and then, in a second exposure, make a blue line print from the Van Dyke negative. If a dark brown line is desired instead of a blue line, the paper used in the second exposure is the more expensive Van Dyke or sepia. The blue line and the brown line prints cost more than ordinary blueprints because they must be run more slowly through the machine. A photostat negative can be used in making a blue line or Van Dyke print, but the results are inferior. If, however, the photostat negative is made with a "paper negative" paper, such as the Kodalith or Photostat N paper, the results are equal to those obtained with a Van Dyke negative.

The production of blue line or Van Dyke prints from paper negatives offers very interesting possibilities in the reprinting of books in very small editions. Unfortunately, it is impossible to get accurate price data, for the cost of production of paper negatives of this type is always included in the price of photo-offset work. The paper negative that can be used in the blueprint technique is exactly the same as the paper negative used in photo-offset work. Since prices are not quoted in the trade, it is necessary to make estimates of cost.

The cost per square foot of paper negative is about three times the cost of photostat paper. The paper negative can be purchased in long rolls and used in the photostat. The cost of changing from one paper to the other in a photostat would be substantial, but it would be absorbed if the total amount of work to be done would be enough to use up a whole roll of paper negative--300 to 500 square feet. Apart from the loading of the roll of paper, there should be no labor costs to render the paper negatives more expensive than photostat negatives. The formula for the lowest reasonable price for paper negatives should therefore stand about as follows: multiply the cost of the paper by three and add the same non-paper cost (labor, chemicals, overhead, profit) that is shown on a photostat price list. An ordinary photostat 8 1/2" x 11" costs $.25 a page if one to five pages are ordered, and $.15 a page if 100 or more are ordered. There is no point in considering the production of a few pages, because of the labor cost of changing the paper in the machine. In the 100-page unit, the cost of photostat paper is $3.34, while the price of the finished photostat copies is $15.00. If the higher-priced paper negatives were used instead of photostat paper, the paper cost would be about $10.00, or $6.66 more than the ordinary paper; then the price of the finished copies could not be less than $21.66, and would probably be more.

Another way of figuring the differences is to consider the quoted price of photostats utilizing a roll of paper 350' x 18". The ordinary paper costs $18.70 in this amount, and the paper negative $50.50. This amount of paper is used in photostat work that, at ordinary prices, costs $119.00. The substitution of paper negative for ordinary photostat paper should increase this price by $31.80, bringing the total to $150.80 instead of $119.00. It is evident that the paper negative must cost about 50% more than the ordinary photostat paper. If the trade should develop business in this line, the differential would probably be greater, but for purposes of estimating in this chapter, the 50% differential will be used. It will be assumed that if photostats could be made for $100.00, the same material could be put on paper negatives for $150.00.

Maximum Use of Area

The standard dimensions in which square footage measurements and prices are calculated in the blueprint industry are shown on the chart. Any area over 42" in width gives rise to a surcharge. The ordinary book or typescript page is too small a unit area to utilize the blueprint economically, but pages can be pasted together in large sheets to fit one or another of the fixed dimensions that are the basis of the price structure. Thus it would cost $.03 to blueprint a page 6" x 9"; but if four such pages were pasted together, the area of 18" x 12" would be blueprinted for $.045, a price per page of $.0125 instead of $.03.

The master copy for a book to be reproduced by the blueprint technique should always be envisaged as a large sheet consisting of pages pasted together. The large sheet can then be folded and cut and bound with the fold at the outside edge--a style of binding used in Chinese book publishing. This makes a book with each page doubled, so that the blank surface is folded in. The blueprint book will then offer the reader the convenience of a book with printing on both sides of the page. Another method is simply to cut up the large blueprint sheets into separate pages.

In blueprinting, as in photo-offset, the master copy can be a photostat negative. It may be an enlargement or a reduction from the size of the original text. The principle of maximum utilization of area requires that the pages be of such size that they will fit without wastage on one of the blueprint areas. Blueprint reproduction is well adapted to the production of editions of less than fifty copies.

Prices per Square Foot

Without losing sight of the fact that the copy must be made to fit the standard dimensions of the industry in order to obtain effective square footage prices, the calculation of the cost of multiplying texts by the different blueprint techniques can be made from the following price list.

Though the blueprint processes have not been used in book production, they have been used in a number of cases to duplicate records. They have been called into service by college registrars to make transcripts of academic records. Mr. Daniel Rich of the University of Michigan has compiled a statement of the relative merits of the B-W process and the photostat for making these copies. Registrar E. B. Stevens of the University of Washington found that he could make copies of transcripts at $.075 each by the B-W process, counting cost of labor and material. There is a society which collects biographical material by interviews with prospects who are flattered by being told that they are distinguished people. The society then deposits the biographical notes in a central office, from which it offers to distribute B-W copies. These uses of the B-W process indicate a most interesting quality. When material is deposited in the form of loose sheets written in strong black on the right kind of white paper, the B-W process will permit the making of inexpensive copies of the original upon demand.

Copying of Documents without a Camera

a) Direct Contact Copying

There are two ways of directly copying documents without the use of a camera and, hence, without reduction or enlargement. If the original document is printed on one side of the page and the page has a fair degree of uniformity and transparency, a contact print can be made from it directly and using a minimum of equipment if a paper such as Insurance Bromide (sold by Eastman), Ad Type paper (Eastman), or Kodalith paper (Eastman) is used. This is a valuable process for the individual scholar who may wish to make copies with a minimum of equipment, whether in his own home or study or where photostat service is not available. It is a process well-suited to the copying of music written on one side of the sheet, for the musician may wish to make a photographic copy of borrowed sheet music.

The cost of materials is simply the cost of the photographic paper plus the chemicals. The equipment is cheap and consists of a safelight, printing frame, or sheet of thick plate glass, and convenient dishes for developing, washing, and fixing. Any darkened room will serve for the work. It should preferably be equipped with electric lighting so that two points or a double plug are available, one for any ordinary electric light bulb and the other for the safelight or red bulb lamp.

TABLE XXV

CHART OF BLUEPRINT DIMENSIONS
(Accepted by the Industry as Basis for Prices in Square Feet)

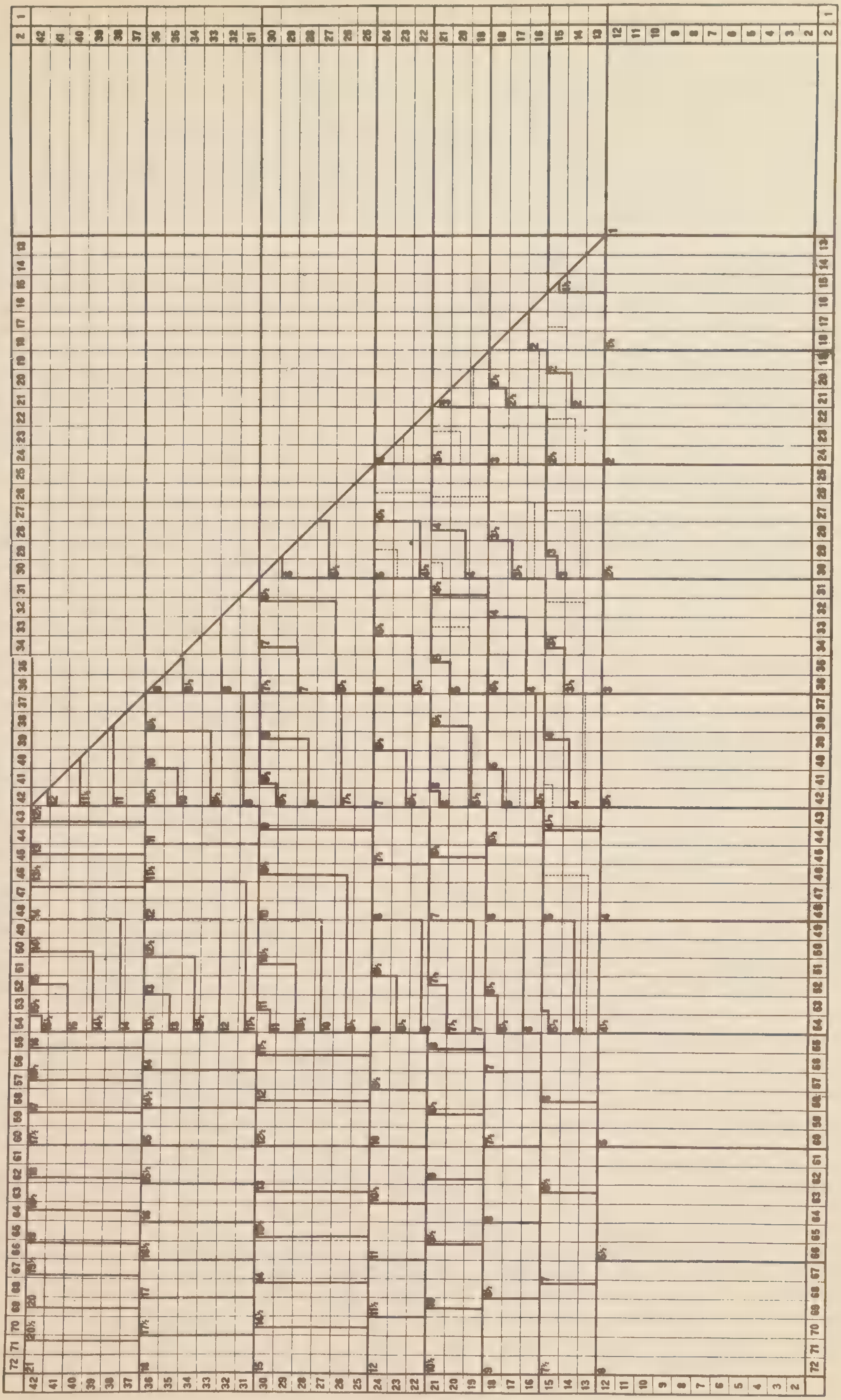


TABLE XXVI

PRICES PER SQUARE FOOT OF BLUEPRINT AND ALLIED PROCESSES*

Process	Form of Original	Form of Copy	Running Cost of Prints
Blueprint on Paper	Black on translucent white, text on one side of page only (as typescript or drawing on linen)	White on blue	$.03 square foot; $.04 sq. ft. in widths over 42"
Van Dyke Negative	"	White on brown	$.08 square foot; $.10 sq. ft. in widths over 42"
Ferro-gallic	"	Black on white	Perishable; not recommended
Lithoprint	"	Black on white	$.06 square foot in quantities of six or more
B-W and Ozalid**	"	Black on white	$.05 square foot; $.06 sq. ft. in widths over 42"
Van Dyke Positive	Paper negative (as for photo-offset) at $.30 - $.37 per sq. ft.; Van Dyke negative at $.08 sq. ft.	Brown on white	$.10 square foot; $.12 sq. ft. in widths over 42". First copy with paper negative will cost $.40 - $.47 per sq. ft., and $.10 each additional ft.; first copy with Van Dykes will cost $.18 per sq. ft., and $.10 for each additional
Blue Line Print (positive)	Same as for Van Dyke positive	Blue on white	$.05 square foot; $.06 sq. ft. in widths over 42". First copy with paper negative will cost $.35 - $.42 per sq. ft., and $.05 each additional; first copy with Van Dyke negative will cost $.13 sq. ft., and $.05 each additional
Photostat Negative (8 1/2 x 11")	(Method of calculating prices is not strictly comparable, but for approximate comparisons, price of one copy is given)		$.20 - $.25. Note that this will vary with successive full use of area and with size of job
Photostat Positive (8 1/2 x 11") from same negative			$.20 - $.25. Full use of area easily achieved; variation principally with size of job. First positive will cost $.40 - $.50, and each additional will cost $.20 - $.25

*Usually there is a minimum order per print of one square foot, and a service and handling charge on orders of less than 100 square feet.

**Prints curl.

In the case of documents which have become yellow with age, improved results can often be obtained by printing through a yellow glass such as the Wratten No. 12 filter or the Wratten Series 00 safelight. In such a case the prints are best made on a paper sensitive to green light such as Kodalith Ortho or Insurance Bromide. Even a lighted match can serve as a source of light in this direct method.

In copying an ordinary page, say of typescript, a piece of photographic printing paper is laid face up and the typescript paper face up on top of it. The two are held together with a piece of glass or in a printing frame, and the light is turned on over them for the appropriate time. The paper is then developed and fixed and comes out as a negative copy not unlike a photostat copy, though with less definition and contrast. The definition is not so good because the thickness of the photographic paper comes in between the surface it is desired to copy and the sensitive surface. If the paper is very thick, or of very close texture, or very dense, then it will be practically impossible to obtain good sharp negatives in this way. In these circumstances it will be necessary to place the printed side of the page in contact with the sensitive paper, print for the required time, and develop to a negative which will be laterally reversed. In order to secure a final positive, a contact print will have to be made from this on another sheet of paper.

b) Reflection Copying

If the page from which the copy is to be made is printed on both sides, then a different process is necessary. Clearly it would not be possible to print through the page. The process to be employed in this case is known as the "reflection copying" or "reflex" process and was originally known as the "Playertype" since it was first put to practical use by an Englishman named Player towards the end of the last century.

In this process a piece of black paper is placed under the page to be copied and a piece of photographic paper of high contrast and orthochromatic, such as Kodalith Ortho (Eastman) or Insurance Bromide, on single weight support is placed face down on top of it with the emulsion side of the photographic paper in contact with the printed surface it is desired to reproduce. The two must then be pressed into very close contact with a heavy piece of plate glass or in a pressure printing frame. This can be helped by using a thin sheet of felt behind the black paper under the page to be copied. The exposure to light is made through the back side of the photographic paper, the exposure depending, of course, on the light source and the distance from it and the speed of the paper used. If the copy obtained in this way is developed, fixed, washed, and dried, it will be a laterally reversed image of the page, and it can be used to make an unreversed positive copy of the page by making a contact print from it on another piece of paper. It is not absolutely necessary to make a positive, although it is usually more convenient to do so. The negatives may be read by a transmitted light, especially if the paper is on a fairly translucent single-weight support. The contact print from the original negative can be made while the negative is still wet after washing, and in this way time can be saved.

The contrast in this process can be improved considerably if the original negative is made by printing in yellow light rather than white light. For this purpose the Wratten Series 00 safelight or the Wratten No. 12 filter is quite satisfactory, and the printing paper must be orthochromatic such as Kodalith Ortho or Insurance Bromide. A suitable printing lamp can be made by using a regular pyramid safelight containing the Series 00 glass, and costing $3.00.

The cost of copying pages by this method as compared with copying pages printed on one side only of a thin sheet of paper is in the extra sheet of bromide paper required.

The Photostat

The best established of the copying methods on photosensitive paper is the photostat method. In the photostat as in the blueprint processes, the unit cost does not diminish as the size of the edition increases. But it can be made to diminish by reducing the dimensions of the pages copied, and hence cutting down at once on the legibility of the finished product and the area of the photographic paper used. This possibility raises in connection with the photostat the same problem of reduction of type size that appeared in connection with photolithography.

In photostating, operating and equipment costs both enter into consideration, for the photostat apparatus is often owned and operated by research institutions themselves.

The costs of photostatic copies are governed principally by the cost of the photostat paper. The price per square foot of a light-weight stock is about $.04. But in the preservation of research materials use may be made of the special "H" or "HH" grade of permanent paper stock, manufactured by the Byron Weston Company. The "H" grade, which is coated on one side, sells for $.052 per square foot; the "HH" grade, which is coated on both sides and hence will bring a saving of half the cost of binding the volumes, sells for $.092 per square foot of paper or $.04 3/4 per square foot of sensitive surface.

When wastage has been taken into account and the variations due to the different ways of imposing the negative and cutting the paper from rolls of different widths has been reckoned with, the cost of paper for photostating a 100-page book in different page sizes and with different grades of paper is as follows below.

To these costs of paper there must added the costs of labor and chemicals. The New York Public Library and the printing department of the Cleveland Bell Telephone Company very kindly contributed statements of their operating costs. In the New York Public Library the great majority of the prints were 11 1/2" by 14", usually one copy only, and the average cost of the paper was $.055. In the Telephone Company the average size of paper was 8 1/2" x 11", and in many cases several copies of the same object were required. The cost of the paper averaged $.03 per page. In the Public Library the $.055 worth of paper requires so much reference and clerical work that the cost of the finished print rises to $.193 each. In the Telephone Company, where only operating room charges need be considered, the $.03 worth of paper is worked up into a print which costs $.063. This means that labor, depreciation, and chemical supplies cost $.033. These operating room costs in the Public Library amount to $.06. The figures in total operating room cost are as follows:

	Library	Telephone Co.
Paper (per 100 pages)	$5.50	$3.00
Operating costs (")	6.00	3.30
	$11.50	$6.30
Cost per square foot for paper, labor, and chemicals	$ 0.10	$0.084

The Public Library spends an additional $.082 on every page to cover clerical help, postage, and desk supplies--charges which are due to the special character of the

TABLE XXVII

COSTS OF PHOTOSTAT PAPER TO PRODUCE A BOOK OF 100 PAGES, IN DIFFERENT PAGE SIZES AND WITH DIFFERENT GRADES OF PAPER USED

Dimensions of Book Page in Inches	Ordinary Stock	"H" Stock	"HH" Stock (Used on Both Sides)
4 1/2" x 8"	$ .62 to $ .82	$ .99 to $1.04	$ .91
5 1/2" x 8 1/2"	1.22 to 1.51	1.72 to 1.95	1.57 to 1.91
6" x 9"	1.40 to 1.83	1.97 to 2.06	1.81 to 2.35
8 1/2" x 11"	2.41 to 3.00	3.38 to 3.73	3.09 to 3.81
11" x 14"	3.95 to 5.01	5.57 to 6.22	5.09 to 6.08
11" x 17"	4.81 to 7.68	6.76 to 9.55	6.18
18" x 22" (page of New York *Times*)	10.18	14.30	

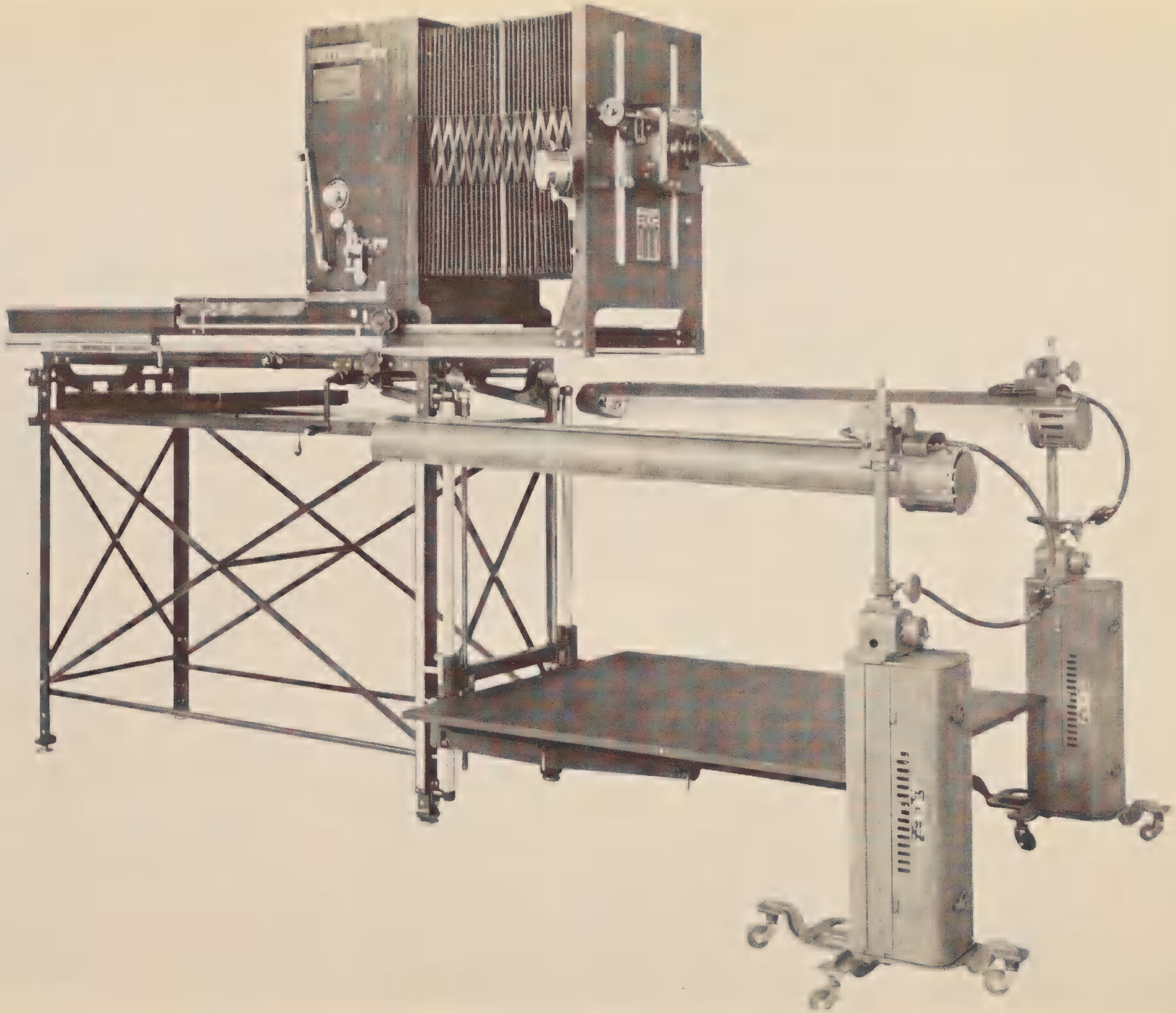
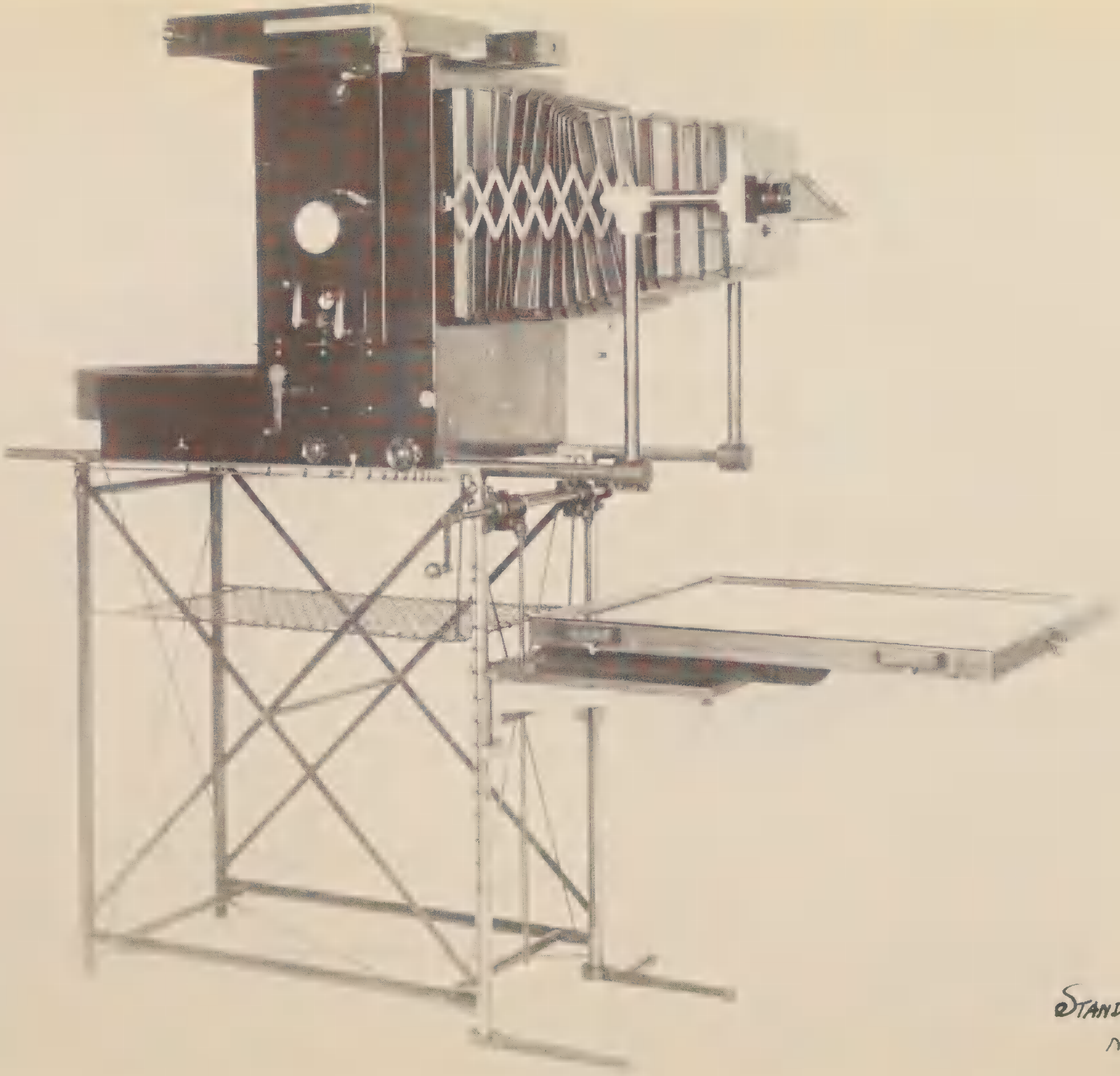


FIGURE XXXVIII

The Photostat



Standard Rectigraph
Model No.1 and 2

FIGURE XXXIX

library work. The inescapable operating costs are 10% more than the cost of the paper and may be more than twice the cost of the paper. This percentage is reduced as the work becomes more continuous. The life insurance companies operate with highly standardized copy; their labor costs should be very low, but the writer has not been able to secure statements from them. The work of the Massachusetts Historical Society in copying colonial newspapers made use of the photostat at its highest efficiency for the reproduction of research materials. A letter from the director, Mr. Worthington C. Ford, explains the financing of this enterprise:

> ...we gave our operator the highest photostat salary paid within my knowledge and with that the cost of material represented twice the cost of labor. I roughly estimated that it cost us about $.13 1/2 to make a page of a newspaper of the large size...but we printed some which required the largest size of sheet adaptable to the photostat machine, and the average cost was not increased. We sold the newspapers at a fixed price of $.15 per page. Some years there was a profit of $300-$400 and some years we came out even.

Similar newspaper photostating by the University of Michigan Library and John Carter Brown Library are being carried on at a rate higher than that charged by the Massachusetts Historical Society. The Library of Congress estimates that its photostat copies of foreign archive material cost it $.15 each, and the British Museum and Bodleian Libraries show a cost of $.06 a page quarto size. It can be concluded that every dollar's worth of photostat paper requires from $.50 to $1.10 in operating expenses.

Commercial prices for photostating service are standardized on the basis of four sizes: 8 1/2" x 11"; 11" x 14"; 14" x 18"; and 18" x 24". The price falls with the number of pages copied, from the high of $.25 a page (8 1/2" x 11") when one page only is copied, to the low of $.15 when 100 pages are copied. The following table charts the prices of any number of pages from one to 100, in any of the four sizes. The price falls by $.01 a page with every increment of five pages. This table will be used in making estimates of cost of photostat work, although actual photostat service may be available at lower prices in some places, or may cost more elsewhere. A spread of two book pages, 6" x 9", will go on a photostat page 14" x 18". If slightly reduced in size, two pages would go on one photostat page 11" x 14".

The "number" is the number of photostat sheets, and may be either duplications of the same pages or reproductions of successive pages of a book. The price is the total price of the number of sheets, but opposite each price group is a unit cost figure indicating price-per-page.

Photocopying Equipment

The two appliances which compete in the field of photographic copying are the photostat (Figure XXXVIII) and the Rectigraph (Figure XXXIX). The photostat is the better known and has succeeded in making a common noun of its trade name. The differences between the two kinds of apparatus do not seem to be sufficiently important to have a decisive effect upon costs but are worth noting because they illustrate certain of the practical aspects of photostat work.

Both firms have two kinds of apparatus: a standard equipment, which leaves it to the operator to shift the prints to a rinsing tank and to dry them; and a "continuous photostat" or "super Rectigraph," which carries the prints automatically through the whole process from exposure to drying. The highest-priced continuous photostat costs $4000.00. The claim is made that it will turn out three prints a minute. The "super Rectigraph" costing $2600.00, is said to deliver prints completely fixed, washed, and dried at the rate of one a minute.

The following are the principal differences between the two machines. The photostat carries the print on an endless chain through a developed bath, then through a chromium roller which squeezes out the surplus developer, into a rinsing tank of running water, and then face down into a shallow fixing tank which is continuously agitated by a motor. The Rectigraph apparatus grasps the end of the paper and pushes it down into the developer,

TABLE XXVIII

CHART OF PHOTOSTAT PRICES

No.	8½x11 PP	11x14 PP	14x18 PP	18x24 PP	No.	8½x11 PP	11x14 PP	14x18 PP	18x24 PP
1	.25-25	.35-35	.50-50	1.00-1.00	51	9.15-18	12.81-25	18.30-36	36.60-72
2	.50-	.70	1.00	2.00	52	9.30	13.02	18.60	37.19
3	.75	1.05	1.50	3.00	53	9.44	13.22	18.89	37.78-71
4	1.00	1.40	2.00	4.00	54	9.59	13.43	19.18	38.36
5	1.25	1.75	2.50	5.00	55	9.74	13.63	19.47-35	38.94
6	1.35-23	1.89-32	2.70-45	5.40-90	56	9.88	13.83	19.76	39.51
7	1.56-22	2.18-31	3.11	6.22-89	57	10.02	14.03	20.04	40.08-70
8	1.76	2.45	3.51-44	7.02-88	58	10.16-17	14.23	20.32	40.65
9	1.95	2.73-30	3.90-43	7.80-87	59	10.30	14.42-24	20.60	41.21
10	2.15	3.00	4.29	8.57-86	60	10.44	14.62	20.88	41.76
11	2.34-21	3.27	4.67	9.33-85	61	10.58	14.81	21.15	42.31-69
12	2.52	3.53	5.04-42	10.08-84	62	10.71	15.00	21.43	42.85
13	2.71	3.79	5.42	10.83-83	63	10.85	15.19	21.70-34	43.39
14	2.90	4.05-29	5.79-41	11.58	64	10.98	15.38	21.96	43.93
15	3.08	4.30	6.15	12.30-82	65	11.12	15.56	22.23	44.46-68
16	3.26-20	4.57	6.52	13.04	66	11.25	15.74	22.49	44.99
17	3.45	4.82-28	6.89	13.77-81	67	11.40	15.96	22.80	45.61
18	3.63	5.07	7.25-40	14.50-	68	11.51	16.11	23.01	46.02
19	3.81	5.32	7.61	15.22-80	69	11.63	16.29	23.27	46.53
20	4.00	5.58	7.97	15.94	70	11.76	16.46	23.52	47.04-67
21	4.17	5.80	8.33	16.66-79	71	11.89	16.64-23	23.77	47.54
22	4.35	6.08	8.69	17.38	72	12.01	16.81	24.02-33	48.04
23	4.53	6.32	9.05-39	18.09	73	12.13	16.99	24.27	48.53
24	4.70	6.58-27	9.40	18.80-78	74	12.25	17.16	24.51	49.02-66
25	4.88	6.82	9.75	19.50	75	12.38	17.33	24.75	49.50
26	5.04-19	7.08	10.11	20.22	76	12.49-16	17.49	24.99	49.98
27	5.23	7.33	10.47	20.93	77	12.61	17.66	25.23	50.45
28	5.41	7.57	10.82	21.64-77	78	12.73	17.82	25.46	50.92-65
29	5.59	7.82	11.17	22.34	79	12.85	17.98	25.69	51.38
30	5.76	8.06	11.52	23.04	80	12.96	18.14	25.92-32	51.84
31	5.93	8.31	11.87	23.73	81	13.07	18.30	26.15	52.29
32	6.11	8.55	12.21	24.42-76	82	13.19	18.46	26.37	52.74-64
33	6.28	8.79	12.55	25.11	83	13.30	18.62-22	26.59	53.19
34	6.45	9.02	12.89	25.79	84	13.41	18.77	26.81	53.63
35	6.62	9.26-26	13.23	26.46	85	13.52	18.92	27.03	54.06
36	6.78	9.50	13.56	27.13-75	86	13.62	19.07	27.24	54.49-63
37	6.95	9.73	13.90	27.79	87	13.73	19.22	27.46	54.91
38	7.11	9.96	14.23-37	28.45	88	13.83	19.37	27.67-31	55.33
39	7.28	10.19	14.55	29.11	89	13.94	19.51	27.87	55.75
40	7.44	10.42	14.88	29.76-74	90	14.04	19.66	28.08	56.16-62
41	7.60	10.64	15.20	30.41	91	14.14	19.80	28.28	56.57
42	7.76-18	10.87	15.52	31.05	92	14.24-15	19.94	28.48	56.97
43	7.92	11.09	15.84	31.68	93	14.34	20.08	28.68	57.36
44	8.08	11.31	16.16	32.31-73	94	14.44	20.21-21	28.88	57.75-61
45	8.24	11.53	16.47	32.94	95	14.54	20.35	29.07	58.14
46	8.39	11.75	16.78	33.56	96	14.63	20.48	29.26	58.52
47	8.54	11.96-25	17.09-36	34.18	97	14.72	20.61	29.45-30	58.90
48	8.70	12.18	17.40	34.79	98	14.82	20.74	29.64	59.27
49	8.85	12.39	17.70	35.40-72	99	14.91	20.87	29.82	59.64-60
50	9.00-18	12.60-25	18.00-36	36.00-72	100	15.00-15	21.00-21	30.00-30	60.00-60

withdraws it up again by the same end, passes it through a roller (but not a bath of running water), covers its surface with the fixing solution, and lets it emerge face up in a deep fixing tank. All these features are interrelated. An advantage of the Rectigraph setup is that as each print is made, it can be examined immediately to determine if it is satisfactory, thus eliminating considerable wastage. The Rectigraph uses a deeper tank because the solution is allowed to lie still; the photostat agitates the tank, which must therefore be shallow. The Rectigraph claims that it can dispense with the agitating of the fixing bath because it covers the whole surface of the paper evenly with the solution before it enters the bath. It is this covering of the surface prior to immersion in the bath which permits the print to appear face up in the tank. The photostat has a much heavier frame, which is necessary to resist the vibration caused by the agitating of the tank, but which has many independent advantages. The Rectigraph wastes more paper than the photostat because it requires more of a margin at the top of the sheet when dipping it into the developer. Each company claims that it is more saving of chemicals. In the judgment of the writer, the photostat has the better claim because the developer is washed off in running water before the print enters the fixing tank; although Rectigraph points out that their chemicals last longer because the tank does not expose as much surface to the air for deterioration.

While it is true in general that the cost of photostat copies does not diminish as the edition increases in size, there is one significant exception. If the user demands a positive copy, the photostat process must provide first a negative and then make the positive from that. A positive copy therefore involves two steps and costs twice as much as a negative. If a number of positive copies are required, the cost of the negative can be distributed among them, thus reducing the cost of each.

On long jobs further economies in the making of photostat positives can be effected by reducing the original copy in the negative and enlarging it back in the positive. The reduction to one-half size at the negative stage can result in two kinds of economy. Only one-fourth as much paper is needed for the negative, and it is often possible when copying back to positives to lay down four negatives at once, copy them all at one exposure, and thus save labor time. These possibilities do not materially reduce the cost level of photostat operations as compared with other processes.

The most extreme use of the principle of making the negative small and enlarging it back in making the positive is the film-copying and enlarging process. If the negative copy is made with a very great reduction--say sixteen diameters--on film, it can be enlarged back on photostat paper with an ordinary film enlarger. This process will yield positive copies on photostat paper for very little more (in some cases for less) than the cost of the negative photostat. The combination of film copying with photostating is important because it redistributes the labor of making photographic copies. One man can go off into the wilds with a small camera to make film copies, while leaving the work of enlarging to be done at another time and place.

Although the apparatus has not yet been designed, it would be very easy to make a semi-automatic machine for enlarging from film to paper. The only equipment to be added to the standard enlarger would be an automatic stepping device to move the film, one frame at a time, before the lens. Large-scale copying work from film to paper has already demonstrated that one worker can do as many as 2000 sheets a day. With automatic apparatus this may be increased to 3000 pages. At such levels the costs of making positives on paper approach the materials costs, for ten dollars worth of labor will use up fifty dollars worth of materials. As will be pointed out in a later chapter, such cost situations introduce a temptation to reduce the size of the paper print to the lowest level of legibility.

Another automatic device is operated by the Recordak Corporation. This is a continuous process machine for transfering a roll of film to an enlarged roll of paper. This service brings the price of the photostat copy to a point very near the price of the photostat paper.

The whole field opened by film copying in reduced sizes will be discussed in a later chapter. For the present it is sufficient to note that film copying and enlarging will yield positive copies on photostat paper for approximately the price of negative photostats.

The Dexigraph

Another type of photocopying equipment is the Dexigraph, (Figure XL), manufactured by Remington Rand. It is a fixed focus camera, copying from a fixed size of object to a fixed size of copy. One of its principal uses in scholarship is for the reproduction of library catalogue cards, although as with the other photostatic apparatus, it is also used for registrars' records, transcripts, etc.

Miss Anna M. Monrad, Head Cataloger of the Yale University Library, has written an article on the experience of Yale Library in using the Dexigraph to make an official catalogue.[1] Miss Monrad's article tells of experience with the automatic Dexigraph; Dr. Frederick Hicks, Law Librarian of Yale Law Library, in the article, "Reproduction of Catalogue Cards by Photographic Methods,"[2] gives an account of experimentation with the Junior Dexigraph, using the machine as a substitute for the typewriter. Computations made for a six weeks' period indicated that dexigraphing 5,417 cards, including material, labor, chemicals, machine rental, and wastage, cost $.0307 per card (5,211 usable cards resulting); typing 5,211 cards cost $.033 per card. Dr. Hicks stated that even if the typing method were cheaper, the use of the Dexigraph would still be justified because of the factors of speed and accuracy. Other users include the Universities of California, Illinois, Missouri, and Notre Dame.

Dexigraph units are leased, not sold. The Junior Dexigraph, handling copy up to letter and legal size, is leased for from $10.00 to $25.00 per month. With this model an operator can Dexigraph from 200 to 400 prints an hour. The Junior Dexigraph is portable and occupies only a few feet of space. The automatic Dexigraph handles all copy from 7 1/2cm. x 12 1/2cm. up to and including 8 1/2" x 14", and is recommended for mass reproduction. The rate of 3,000 cards an hour is claimed for it. It can be leased for a one-year period for $50.00 a month, but Remington Rand ordinarily uses it on a contract basis when a specific assignment for a job of some magnitude is required.

Dexigraph copies, like photostat copies, are produced as negatives. Sensitized paper is used, and it comes in precut or roll form. The price varies according to weight, size, and type of paper. Standard Record paper ranges in price from $6.80 per 1,000 sheets 5" x 3", up to $32.00 for 1,000 sheets 8" x 8"; Permanent Record paper begins at $8.80 per 1,000 cards 5" x 3" and goes up to $39.75 for the 8" x 8" size; Duplex Permanent Record paper is more expensive. The roll paper is priced from $8.60 to $19.00, according to weight and size. Permanent Record paper is heavier than Standard Record paper and is sensitized on a paper stock resembling an all-rag stock. Dexigraph claims that the cost of labor, chemicals, material, etc., for centimeter cards should not exceed $.02 each where a quantity is involved; the legal size documents run about $.07 each. Both these figures include machine rental.

Through the use of a color filter, colored paper can be copied. The turn of a dial varies the amount of light entering and consequently determines the amount of contrast desired.

Ira W. Smith, in a report of April, 1934, on methods of duplicating records, says that the University of California at Berkeley used the Dexigraph and made prints at a cost of approximately $.03 each, including cost of paper, developing materials, and labor, when the volume of work was fairly large. The cost when only a few prints were made at a time was about $.07 each.

The Technological Frontier

It is to be hoped that a means may be found to combine the economies due to saving of material in film copying with those due to labor saving in the Dexigraph. It should be possible to develop an automatic machine for enlarging film copies to a fixed size. Such a device would bring photostat costs down very close to mere photostat paper costs. If such a device should then be developed to take full

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[1] "The Use of the Dexigraph in Making an Official Catalog," Library Journal, March 1, 1932.

[2] A paper read at American Law Library Convention in Montreal in 1934.

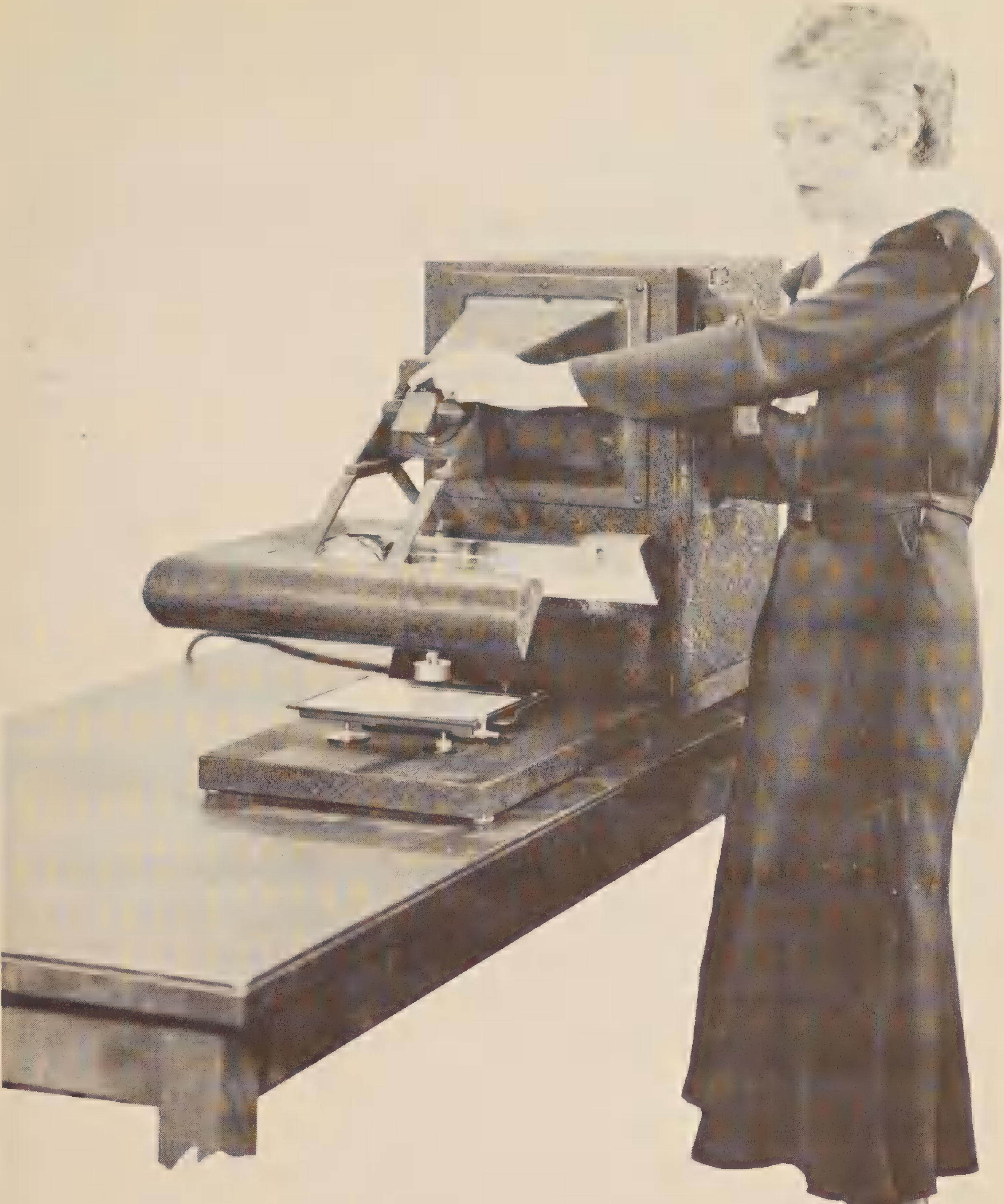

FIGURE XL

The Dexigraph

advantage of the possibility of saving photographic surface by reducing the size of the reading matter, photostatic copies might enter a new cost level and hence acquire a new importance in the strategy of scholarship. The Joint Committee has heard that there is some prospect of development along this line.

Typescript can serve as the master copy from which B-W and blueprints are made, provided it is written with a very black ribbon. It can serve as master copy for the photostat process without special preparation. To bring together all the processes for multiplying a typescript book, it is only necessary to imagine that a typescript of 100,000 words is submitted for multiplication in the form of a fair copy, 334 pages, 8 1/2" x 11".

How shall this be multiplied? It can be retyped for the format copy and reproduced by hectograph, mimeograph, or photo-offset. It can be photostated full size, half size, or in some intermediate size. If it happens to be typed in sufficiently dark print on the right kind of paper, it can be reproduced directly by any of the blueprint processes. If it is not sufficiently contrasted for the direct use of a blueprint process, it can be photostated and blueprints made from the photostat negatives. Each of these processes will result in a legible product; the exact differential in legibility is difficult to estimate. Each of them will exhibit its principal cost advantages at a particular part of the rising curve of edition size.

Comparative Costs in Book Production

It is now possible to compare costs of blueprint, photostat, and photo-offset in book production.

The original to be reproduced may be either a printed book or a pile of typescript. An octavo book of 100,000 words, 6" x 9" page, with 400 words to the page would cover ninety-four square feet. A typescript of normal format, 300 words to the page, would require 334 pages, 8 1/2" x 11", or 217 square feet.

The alternatives that present themselves in the reproduction of these texts are (a) typescript copying, (b) photostat, (c) blueprinting, and (d) photo-offset.

Six of these processes (blueprint, blue line print, Van Dyke negative, Van Dyke positive, B-W, and Ozalid) are incapable of enlarging copy or reducing it, and equally incapable of dealing with such a thing as a book with pages printed on both sides. Those that involve the use of the photostat are adapted not only to the reproduction of book pages, but also to the making of reductions. Since area is the governing factor alike in first and running costs, the cost levels are highly sensitive to reductions in size. In this respect, blue line prints or Van Dyke positives from paper negatives yield productions at costs just as elastic as those encountered in photo-offset and analyzed in the preceding chapter. That is to say, a reduction of approximately 30% in the size of the page will reduce costs by 50%. The 6" x 9" page would have to be reduced to something like 4" x 6"; the 8 1/2" x 11" page to something like 5 1/2" x 8 1/2", to effect this reduction in cost.

In respect of size of edition, the zones in the neighborhood of five copies, and again in the neighborhood of twenty-five copies, show themselves as the most sensitive. They are the meeting points of the different techniques. Carbon copying, Ozalid, and B-W copying come very close together at the fifth copy; photo-offset, photostat, and Van Dyke positives meet each other close to the twenty-five mark.

The key figures for the cost of reproduction (full size) are on page 79.

Photostat and photo-offset cross each other in the reproduction of the octavo book at the twenty-five copy line. In the reproduction of the typescript page they meet at a smaller edition--thirteen copies. That is to say, in an edition of thirteen copies the photo-offset of an 8 1/2" x 11" page will cost the same as the photostat, and there will be eighty-seven extra photo-offset copies, the cost of which has been absorbed in the edition of thirteen.

Why is there this difference? Chiefly because the negatives in the dimension 6" x 9" can be laid on the frame for photostating in a very economical way, and eight pages can be copied at a time.

Another fact must be noted: the photostat and blueprint techniques are all elastic in that additional copies can be run at constant cost, once the first costs are assumed. With the photo-offset

TABLE XXIX

COMPARATIVE COSTS OF TYPESCRIPT, PHOTOSTAT, BLUEPRINT AND PHOTO-OFFSET

For the Reproduction of a Book of 100,000 Words, in 250 Octavo Pages, or 334 Page Typescript

	Description of Method	First Cost	Running Cost	Edition or Unit Costs	No. of Copies in Edition									
					1	2	3	4	5	10	25	50	100	200
Book or Typescript	Typescript and carbons			Edition	40.00	40.00	46.93	53.86	60.79					
				Unit	40.00	20.00	15.65	13.47	12.16					
Book of 250 pages 6" x 9" copied full size	*Photostat positives. (Negatives laid 8 up on frame 18 x 24)	37.50 for negative	10.20 after 3rd copy	Edition	61.92	81.43	96.02	113.30	132.50	183.50	336.50	581.00		
				Unit	61.92	40.72	32.00	28.30	26.50	18.35	13.46	11.62		
	Note: if the photostat negative is used as a copy and counted as such, the unit costs in the series would be			Unit	37.50	30.96	27.14	24.00	22.66					
	*Van Dyke Positives from Paper Negatives	56.25	9.40	Edition	65.65	75.05	84.45	93.85	103.25	150.25	291.25	526.25		
				Unit	65.65	37.53	28.15	23.93	20.65	15.02	11.65	10.52		
	*Blue Line Print **Positives from Paper Negatives	56.25	4.70	Edition	60.95	65.65	70.35	75.05	79.75	103.25	173.25	291.25	526.25	
				Unit	60.95	32.83	23.48	18.78	15.95	10.32	6.95	5.85	5.26	
	*Photo-offset	343.75 (for 100 copies)	50.00 (additional 1000)	Edition	343.75		constant edition cost to one hundred						343.75	393.75
				Unit						34.37	13.72	6.86	3.43	1.96
334 pages typescript copied full size, (typescript suitable for blue-printing) full size	Blueprint		6.51	Edition	6.51	13.02	19.53	26.04	32.55	65.10	162.75	325.50		
				Unit	6.51	6.51	Constant unit cost				6.51	6.51	6.51	
	**Blue line print from Van Dyke negative	17.36	10.85	Edition	28.21	39.06	49.91	60.76	71.61	125.86	271.25	559.86		
				Unit	28.21	19.53	16.64	15.19	14.32	12.58	11.55	11.20		
	Brown line (Van Dyke) positives from Van Dyke negatives	17.36	21.70	Edition	39.06	60.76	82.46	104.16	125.86	234.36	559.86			
				Unit	39.06	30.38	27.49	26.04	25.32	23.43	22.38			
	Ozalid or B-W (makes black or dark red on white)		10.85	Edition	10.85	21.70	32.55	43.40	54.25	108.50	271.25	542.50		
				Unit	10.85	10.85	Constant unit cost			10.85	10.85	10.85	10.85	
	*Photostat positive (if negative is counted as first copy)		50.10	Edition	50.10	100.20	150.30	200.40	250.50	501.00	752.50			
				Unit	50.10	50.10	Constant unit cost			50.10	50.10			
	*Photo-offset (full size)	668.00 for 100 copies	100.20 for extra 1000	Edition	668.00		Constant edition cost to one hundred						668.00	768.20
				Unit						66.80	26.72	13.36	6.68	3.84

*The costs of all starred processes can be cut approximately 50% by reducing the size of the copy to 70% of full linear size.

**A university makes blue line prints from paper negatives on a non-profit basis at 1 1/2¢ per page, 8 1/2" x 11".

TABLE XXX

KEY FIGURES OF UNIT COSTS OF REPRODUCTION

One Copy of 100,000 Words, Unit Cost		
Typescript	$40.00	(from either book or typescript)
Photostat negative	37.50	(from book only)
Ozalid or B-W	10.85	(from typescript only)
Five Copies, Unit Cost		
Typescript and carbons	$12.16	(from 6" x 9" book or typescript)
*Blue line print from paper negative	15.95	(from book only)
Blue line print from Van Dyke negative	14.32	(from typescript only)
Ozalid or B-W	10.85	(from typescript only)
Twenty-five Copies, Unit Cost		
Photostat	$13.46	(from 6" x 9" book only)
Photo-offset	13.72	(" " " " ")
Van Dyke positive from paper negative	11.65	(" " " " ")
Blue line print from paper negative	6.95	(" " " " ")
Blue line print from Van Dyke negative	11.55	(from 8 1/2" x 11" typescript only)
Ozalid or B-W	10.85	(" " " " ")
Photo-offset	26.72	(" " " " ")
Photostat	50.10	(" " " " ")

technique, the full edition must be made at one running.

The foregoing discussion has dealt with printed and typescript texts. It is important, however, to take into account the fact that all the blueprint, photo-offset, and photostat processes will reproduce charts, figures, and line drawings as easily as texts. This aspect of the problem of reproducing research materials will receive more complete analysis in the next chapter.

CHAPTER VII

BOOKS CONTAINING CHARACTERS NOT IN THE ROMAN ALPHABET, TABULAR MATTER, DIAGRAMS, AND ILLUSTRATIONS

Classification of Special Problems

The analysis of composition costs of printed and typescript books has been made on the assumption that the vehicle for the recording or communicating of thought was to be a text consisting of words written in the Roman alphabet. Under those conditions, composition costs follow the number of words. Two thousand words cost twice as much as 1000 words.

There are, however, a number of variants of this situation, each of which affects the computation of costs in their relation to quality of product. These variant ways of presenting thought can be classified as follows:

I. Presentation of thought in words and numerals.
   A. Words in the Roman alphabet and numerals arranged as usual in horizontal lines, but with variations in size or body introduced for purposes of emphasis. (Use of italics, bold-face, or smaller point size in footnote material.)
   B. Words in the Roman alphabet and numerals arranged in vertical as well as horizontal lines. (Tabular material of all kinds.)
   C. Words interspersed with characters not in the Roman alphabet, or numerals not arranged in simple horizontal lines. (Texts that include quoted Greek, treatises with intricate formulae.)

II. Pictorial presentation of thought.
   A. Black and white drawings. (From the standpoint of reproduction technique, diagrams, graphs, maps, and pictures in black and white are the same.)
   B. Photographs or wash drawings. (The essential fact is that the reproduction must distinguish different degrees of light and shade; instead of the sharp contrast of black and white, there are continuous variations in tone.)
   C. Color reproduction.

In every case where one of these vehicles for the presentation of thought is used in connection with a text, the extent of its use may be great or small; there may be many footnotes or few, many or few Chinese characters may be interspersed, there may be only one or two tabulations in a whole book, or the book may consist almost entirely of tabular materials. The pictorial material may be a greater or less proportion of the whole content of the book, it may be in the form of larger or smaller areas, large maps and charts, page-size photographs, or small pictures or charts filling each only a part of a page.

In respect of all these variants of the "normal" book, the same fundamental distinctions hold between large and small editions, between running costs of processes like relief printing, which reduce the cost of each copy as the size of the edition increases, and of processes like the photostat, which have constant costs per copy regardless of size of edition. With costs, there are also correlated different degrees of legibility in the case of words and numerals, and different degrees of fidelity of reproduction in the case of pictorial matter. There are variations in beauty in the final product that follow from the adoption of one or another technique, or the assumption of one or another cost. There is a cost differential between the reproductions of text and picture that are sufficiently legible and faithful for the accurate transmission of thought, and reproductions which go beyond this necessity in order to give aesthetic pleasure to the reader.

The processes already described--relief printing, photo-offset, typescript, hectograph, mimeograph, manuscript with photo-offset, blueprinting and photostating--all reappear in various combinations in the multiplying of materials of these various kinds. Descriptions and cost analyses of these processes contained in the preceding chapters can be applied to the problem presented here.

Reproduction in Typescript, Manuscript, and Relief Printing without Pictorial Matter

When a text consists of words in the Roman alphabet, arranged in horizontal lines, but with variations in size or body, the ordinary typewriter begins to lose efficiency in comparison with the linotype or monotype on the one hand and the Varityper on the other. The standard typewriter can introduce only three variations into the form of a text: it can underline words or sentences, change the interlinear spacing, and change the length of line. These variations are usually introduced in typescript to set off quoted matter from non-quoted matter. They do not always materially increase typescript composition costs, and they affect multiplying costs of typescript books only in so far as these interfere with the use of non-standard interlinear spacing. If the spacing of four and one-half or five lines to the inch is used with pica typescript, the quoted matter cannot be set off from the regular text by reducing the interlinear spacing. If footnotes are to be introduced, the composition cost is increased by the need for careful calculation to distribute the page correctly between the text and footnote.

The disadvantage of the standard typewriter in the preparation of typescript material with footnotes for photo-offset reproduction can be met to some extent by the use of paste pot and shears in the making of the format copy. The footnotes can be typed separately with an elite or micro-elite machine, and pasted on the bottom of the page of text.

The Varityper will allow the introduction of a greater number of varieties of typescript faces and the text and interlinear spacings. The linotype or monotype is still more elastic in this respect.

Composition costs will sometimes increase with the introduction of these variants. To give a quantitative comparison of the increase in cost is not practical. The differences do not seem to be great enough to have decisive influence on the choice of techniques, unless (in the case of typescript composition) the need for the Varityper machine should make it impractical to calculate typescript composition costs on any basis save that of the prices of format copying offered by photo-offset companies. In a particular case these shop prices may be so much higher than the office costs of standard typescript composition that the change from typescript to relief printing would be indicated.

In the preparation of tabular matter, the linotype or monotype exhibits advantages because it facilitates the centering of text on a page and of the headings of columns. The typewriter stands at a disadvantage in the preparation of tabular material because of the lack of elasticity in the size of letters in the headings of columns. The mimeoform process is not well adapted to the production of tabular material because it does not easily reproduce vertical lines. The typewriter also shows its limitations when vertical lines on a page are desired.

If tabular material is to be given its maximum beauty and clarity, it may call for manuscript composition. The kind of skill in lettering and numbering that is used in the manuscript composition of tabular material is widely available, since it is developed by the engineering profession and taught in vocational schools as "mechanical drawing." The three techniques available for the reproduction of tabular material are, then, relief printing, typescript with or without photographic multiplying, and manuscript with some photographic techniques of multiplying (blueprinting, photostating, photo-offset, etc.).

Cost comparisons are difficult to establish among the three kinds of composition of tabular matter. In linotyping, the extra charge for tabular matter may run from 75% to 600%; in typescript, from 25% to 200%; and the cost of manuscript preparation of tables can be guessed from the fact that draughtsmen are available at wages of $.60 per hour for ordinary skill and $1.00 per hour for high skill, and that their speed is much less than that of a typist.

When words are interspersed with characters not in the Roman alphabet, the non-Roman characters may happen to be in another alphabet (i.e., Greek or Russian) that is available as a special matrix for the linotype, or as a special type font, or a special type plate for the Varityper. A font of type sufficient for occasional Russian words in a book costs $30.00 or $40.00; a Varityper type plate costs $5.00 in bakelite and $8.50 in metal; a font of Chinese type varies in cost according to completeness. There could be no linotype matrix or Varityper type plate for Chinese on account of the number of the symbols.

The only alternative to the use of the special matrix, type font, or type plate is the use of manuscript. The text, as typed or printed in Roman characters, can be interspersed with the Chinese or other characters by hand. If the whole book is to be printed by relief printing, these hand-drawn symbols can be made into small line cuts, exactly as if they were drawings, and filled into the spaces left in the linotype or monotype composition; if the book is to be reproduced by a photographic technique, they can be drawn in place upon the typescript or printed format copy,[1] after which no special costs will arise.

In the case of a Bibliography on Northeastern Asia, compiled by Professor Kerner of the University of California, there were 13,500 items, of which 5,000 titles were in the western language; 3,500 in Russian; 2,500 in Chinese; and 2,500 in Japanese. Letterpress reproduction was out of the question because of the high costs involved in connection with the foreign languages and the small-edition size; photo-offset was the ideal process for the job. The method proposed in the making of the master copy was to have the English typed in first, space being gauged and allowed for the other titles. The Russian was then to be typed in with a Hammond typewriter; these pages in turn were to be given over to a student who would write in the Chinese and Japanese characters by hand, in a size proportionate to the typing. The pages would then be ready to serve as the master copy for the photo-offset work. Estimates for the composition cost of the master copy ranged from $1,200 to $3,000.

The need for special equipment and special skill in the reproduction of materials with non-Roman alphabet content limits the competition for the work to certain specially favored plants. The author himself may be in a position to assume some of the composition costs by filling in the non-Roman symbols in spaces left for the purpose in the typescript or printed composition. This shifting of composition cost toward the author is a normal possibility in the production of typescript books; it becomes especially important if the preparation of the format copy requires a rare skill or knowledge that the author happens to command, either in himself or in his assistants.

Techniques in the Reproduction of Pictorial Matter

There are six fundamental techniques for the reproduction of pictorial matter. All of them involve the use of photography and hence permit enlargements or reductions from the original picture. The costs of all of them are fundamentally area costs and running costs, for one can hardly speak of a composition cost factor in the reproduction of pictures. Most of them have already been described and analyzed in connection with the reproduction of texts. They must here be given further description and classification.

The six fundamental techniques are the following:

1. Relief processes. These come up from the original wood-block technique. Ink is carried to paper on the raised part of the printing surface. The standard forms in which this technique appears in small edition book publishing are the zinc cut and the zinc or copper photoengraving.
2. Planographic processes. These are related to the original lithography. A plane surface differentially receptive to ink receives the ink from a roller and transfers it to the paper. Photo-offset is the standard form.

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[1] Note that in this case a single copy of the book would be printed as page proof, filled in by hand, and then multiplied by photo-offset.

3. Intaglio processes. These are variants of etching. Ink is carried to paper in the sunken parts of a metal surface.
4. Photogelatin or collotype. This process bears some resemblance to planographic processes because the printing surface is differentially receptive to ink and moisture, some resemblance to intaglio because there are actually raised parts of the surface that reject ink and depressed parts that receive it.
5. Photosensitive paper processes. These are blueprinting, photostating, and photography. In these processes there is no use of ink. The paper used for multiplying the pictorial matter is covered over its entire area with a photosensitive surface and then subjected to the action of light and to chemical action that transfers the image to it.
6. Projection image processes. These correspond to microcopying. They are the same as those using photosensitive paper except that the image is developed on a transparent medium (glass or film) in a reduced size and then rendered useful by projection on a screen.

Color production processes are variants of these. They will receive no special discussion in this chapter, not because they lack importance, but rather because their complexity makes analysis of costs and results difficult, and their place in the reproduction of materials of scholarship is subordinate to that of the monochromatic processes.

In all of these processes there are different degrees of fidelity in reproduction of pictorial matter. These differences are of two kinds: differences in fineness of detail and differences in fineness or accuracy of tone.

The fineness of detail is primarily a resultant of size. An original picture multiplied in a copy 6" x 9" will show more detail than the same picture multiplied in a copy 3" x 4 1/2". But the method of reproduction has something to do with it. The 3" x 4 1/2" copy made by the photosensitive paper process on a good bromide paper might show more detail than the 6" x 9" copy made on photostat paper; the smaller copy carefully photoengraved with a high screening would show more detail than the larger copy done with a low screening. These terms will be explained below; the essential fact to be established at this point is the quality of fineness of detail as an element in the reproduction of pictorial matter.

The variations in accuracy or fineness of tone are evident in the first instance in the contrast between a pen and ink drawing and a photograph. The pen and ink drawing has but two tones--black and white; the photograph has a number of intermediate tones. Some processes of reproduction (such as telephoto on newsprint paper) will render with recognizable distinctness only three or four tones; photography on a soft bromide paper will render so many different tones that the measure of them is given not by the actual surface of the picture, but by the sensitivity of the human eye to distinctions in light intensity.

Moreover, some processes will show the maximum number of distinctions in tone in the lighter greys and will cause all the darker areas of the picture to take on a flat black. This is especially true of the photogelatin process. Others will bring out very clearly the different tones in the darker areas but show few differences of shading in the lighter parts. The success of a particular process in separating the tones of a picture carries with it success in exhibiting some kinds of detail.

Another distinction to be made between these processes is their different degrees of adaptability in the combining of pictorial and textual matter. The relief pictorial processes combine with relief printing in the production of books, the planographic processes with photo-offset printing. Intaglio and photogelatin processes are used for the production of pictorial matter separate from text but are capable of being combined with text in a bound form. There seems to be no good technical reason for not combining photogelatin pictorial work with reproduction of text by photogelatin, though the combination has not actually entered trade practice. Pictures made on photosensitive paper can also be bound into books. Only pictures made on transparent media for projection are absolutely incapable of combination with text in book form. Any or all of these processes can be used to reproduce pictorial matter in a form or size that will not be bound with the text in a book but will go to the reader of the book as a separate item.

Photoengraving and Photo-Offset

The fundamental elements of the photo-offset process have been explained in the chapter on the reproduction of out-of-print books and have received further reference in the chapter on the photo-offset reproduction of typescript books.

The first part of the photo-offset process is the fundamental one in the reproduction of pictorial matter in large editions, because it appears not only in the production of books by photo-offset, but also as an intermediate stage in the preparation of line cuts and photoengravings for relief printing.

The first stage in this process is the making of a photographic negative. While photolithographers have developed the use of film and paper negatives, photoengravers have remained loyal to the wet plate process for making negatives. There is no technological reason for this; it is the result rather of the traditions of the craft.

The photographic negative is then transferred to a sensitized metal surface. The image is burned on to a zinc sheet that has been coated with albumen and ammonium bichromate, the unfixed emulsion is washed off, and the zinc surface is inked. Up to this point the photo-offset process and photoengraving process are the same. So far as the chemical quality of the metal surface is concerned, it would be ready to be clipped on to a photo-offset press. But an additional stage is necessary if the metal is to be prepared for relief printing.

The additional step, required for the sake of using the relief printing principle, is an application of an acid etch to the prepared zinc sheet. The inked plate is dusted with powdered resin or "dragon's blood," which adheres to the ink and falls off the clean metal. The dragon's blood is melted into place by warming the zinc. This will protect the printing surface from acid. Then the zinc is bathed in acid. Repeated baths of acid and coatings of dragon's blood cut away the exposed parts of the plate and leave the protected parts as a raised printing surface. When the printing surface is prepared in this way, it is tacked on a wooden block and is then ready to be fitted in with linotype slugs or monotype composition in a flat-bed press.

Of course the two processes are not in practice as interchangeable as this description might make it appear. The photo-offset worker uses a special thin metal sheet, which may be aluminum rather than zinc; the photoengraver uses a heavier sheet of metal which he will cut up into blocks. He may use copper or nickel instead of zinc. The traditions of the two crafts are very different, but the chemistry of the process is the same, save that the photoengraver must carry out an additional step, namely, the acid etch.

In the photo-offset process this preparation of the printing surface is identical for text and for black-and-white pictorial matter. In the relief printing process the preparation of the printing surface for the text by linotype is quite different from the preparation of the pictorial printing surface or line cut. Therefore, in relief printing, an additional cost factor must be taken into account--the fitting together of pictorial and textual printing surfaces. This cost factor is absent from the photo-offset process.

Half-tone Pictures in Photo-Offset and Photoengraving

Photo-offset and photoengraving present the same similarities as and differences from other processes when pictorial matter to be reproduced is not a black-and-white image, but a half-tone picture showing different shades of grey. To print, whether by photo-offset or relief technique, a picture that will show different shades of grey requires resort to an optical illusion.

If a number of small dots on a white ground are seen from a reading distance they will appear to run together as grey. The grey will be lighter or darker according to the density of the dots--that is to say, according to the proportion of the paper surface they occupy. The tone will seem smooth or rough according to the size of the dots. The photoengraver or photo-offset printer, when he reproduces a photograph, renders the greys intermediate between black and white by printing aggregations of dots. The newspaper reproductions of photographs are so coarse that they can be analyzed by the naked eye into their constituent arrays of dots; there are small black dots in the lighter greys, larger ones in the darker greys, while in the darkest greys the black dots run together, leaving small white dots between them.

To break the continuous tones of an original photograph into a printing surface that will, by putting dots on paper, give an illusion of a comparable range of tone, the photoengraver or photolithographer prepares his negative in a special way. He uses a "screen." The screen is a combination of two sheets of glass, ruled diagonally with opaque lines crossing at right angles, and cemented and bound together. When the light passes through such a screen, it reaches the plate in dots and so causes the image on the negative to appear in dots also. Four main factors determine these dot formations: the amount of light reflected by the copy (i.e., the light and shade tones of the photograph that is being copied), the size of the openings used in the camera, the distance of the screen from the photographic plate, and the fineness of the screen. The fineness of the screen is expressed in lines to the inch and varies from 45 to 400.

The screening of the photograph is a stage in the preparation of the negative, whether wet plate, film, or paper. When the screened negative has been prepared, the further steps in the process, whether for photo-offset or relief printing, are identical with the steps that must be taken in the case of black-and-white drawings.

There has been devised a special kind of screen made up of very small lens formations stamped in a sheet of heavy transparent cellulosic film. It is said that this screen simplifies the work of making screened negatives and may therefore reduce the skilled labor element in the cost of making screened photographs.

Half-tones screened up to 100 to the inch are made on zinc, above that they are usually made on copper, and very fine screening is done on nickel. The photo-offset press can reproduce half-tones screened as fine as 175, but generally uses screens from 120-150 lines to the inch. The ordinary photographic work seen in the advertising pages of magazines is screened 120-135 lines to the inch; newspaper photographs are screened 45 to 65 lines; the aquatone process, a variant of photo-offset, uses screens up to 400 lines to the inch.

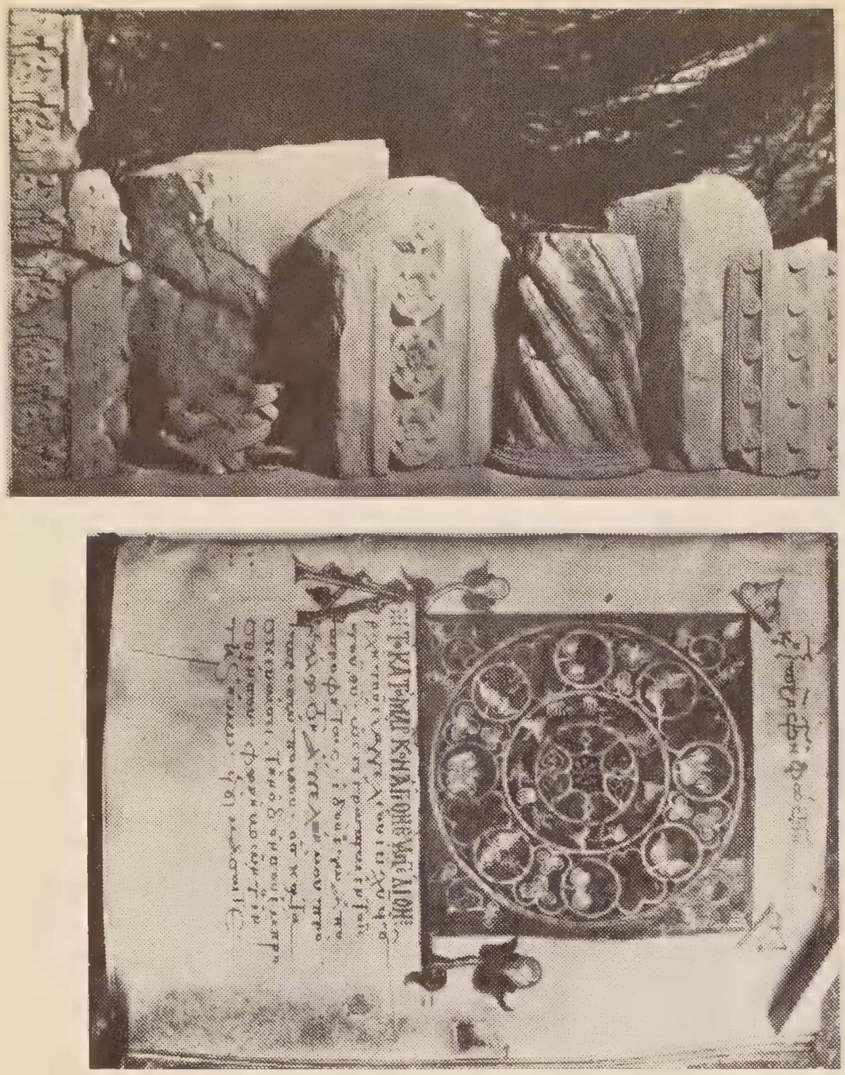
In general, the finer the screen the more faithful will be the reproduction of detail. The reader who would appraise the effect of refinement in screening upon rendition of detail and richness of tone is referred to the exhibits bound herewith. (Figures XLVI-XLIX.) The photographic work on the finer screens is no more costly than on the coarse screens, but the printing is more difficult. The finer the screen the more careful the presswork must be, and the smoother the finish of the paper upon which it is to be printed. The photo-offset-press does not require the delicate make-ready necessary with highly screened plates on a flat-bed press, but the tones rendered by the offset method often appear flat in contrast with the products of photoengraving.

The Large and Small Offset Presses in Pictorial Work

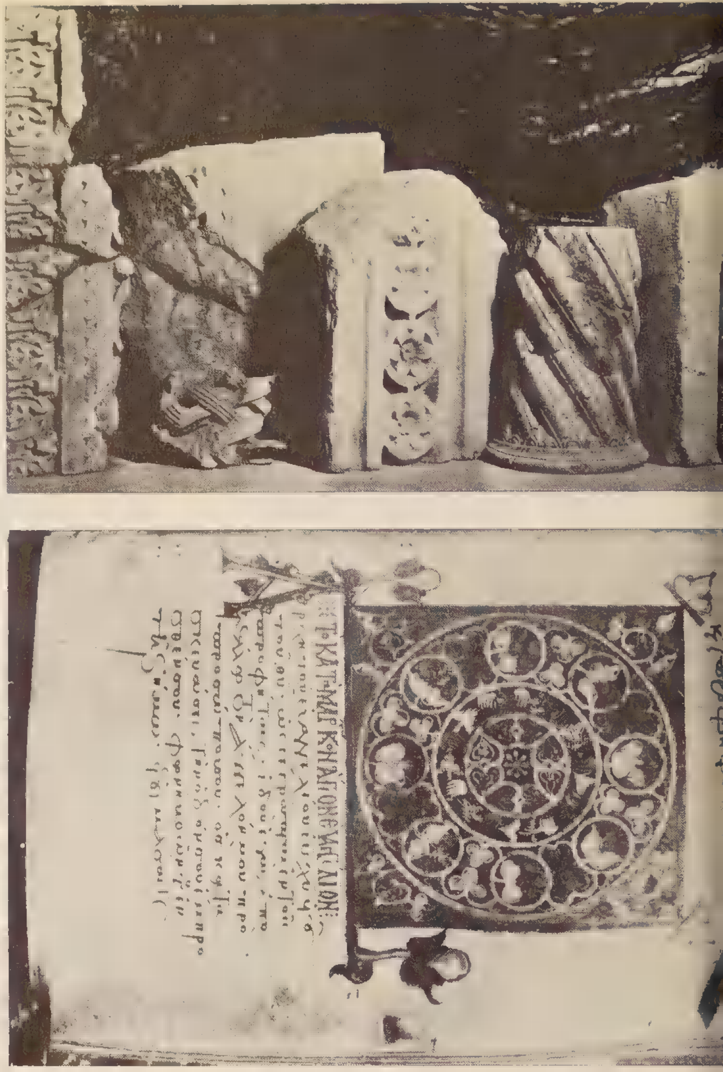
In Chapter III, on reprinting of books, it was stated that there are two kinds of photo-offset presses: the large press, such as the Harris press, used by printers for commercial work; and the smaller presses, such as the rotaprint and multilith, used also as office equipment by non-professional operators. In Chapter V, on the typescript book, there was included a discussion of plate size in connection with format, and of the use of direct typing on the metal sheet of the smaller photo-offset presses.

In this chapter, where illustrative material is under discussion, it becomes necessary to compare the efficiency of the large and small presses in respect of fineness of work. Needless to say, the quality of a press is reflected in its work in the reproduction of books out of print and in the reproduction of typescript books; but the presswork becomes most important when screened photographs are to be reproduced, for differences in quality of presswork manifest themselves most clearly in the reproduction of half-tones.

The representatives of the



This is 80-screen



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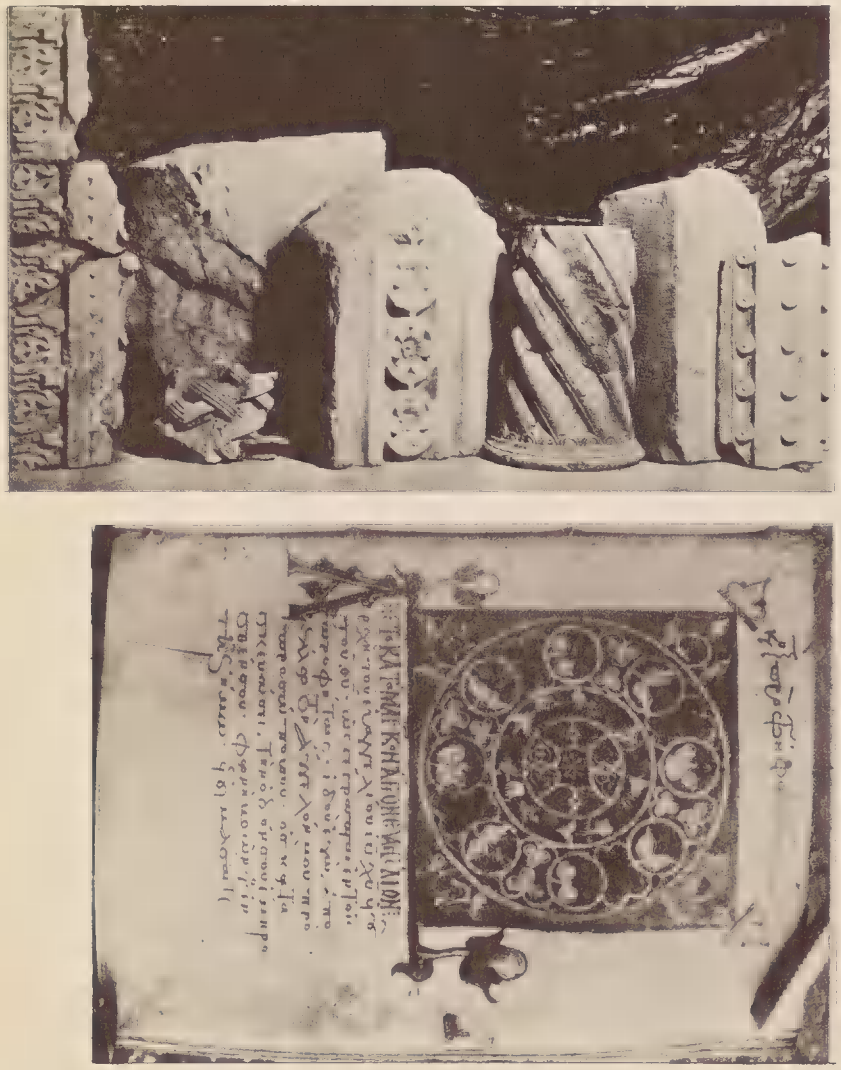
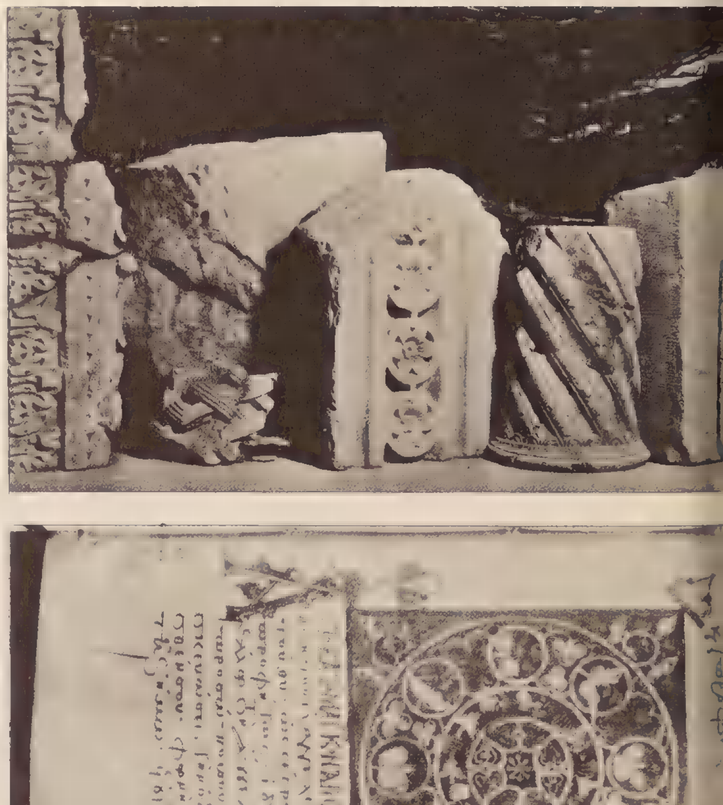


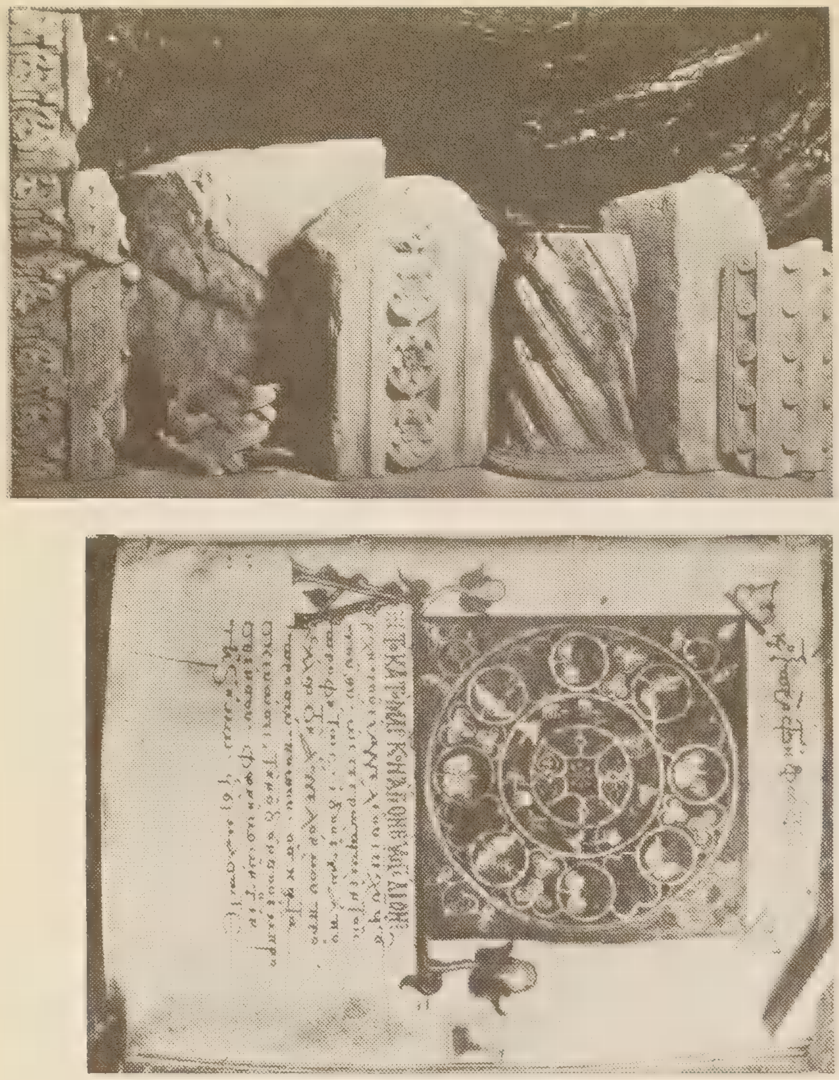
This is 150-screen



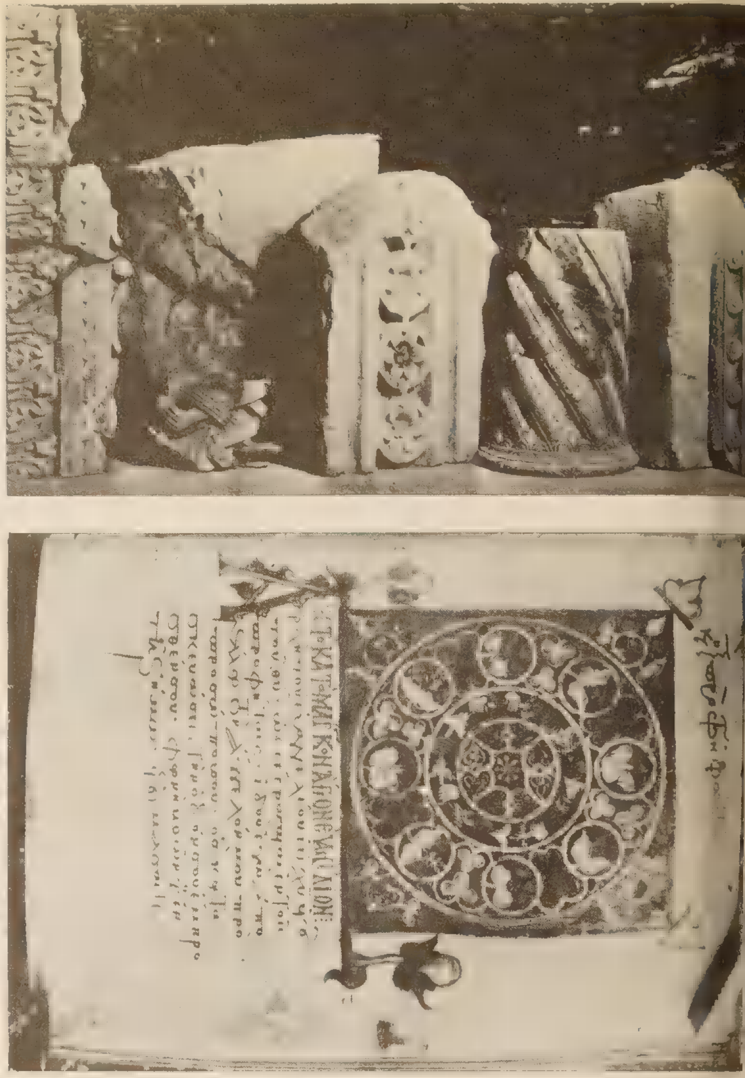
This is 175-screen

FIGURE XLI

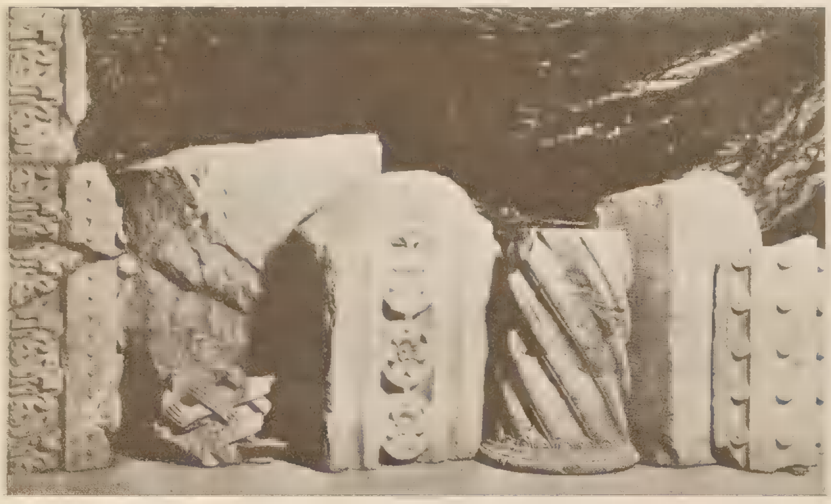
WORK DONE ON HARRIS PRESS



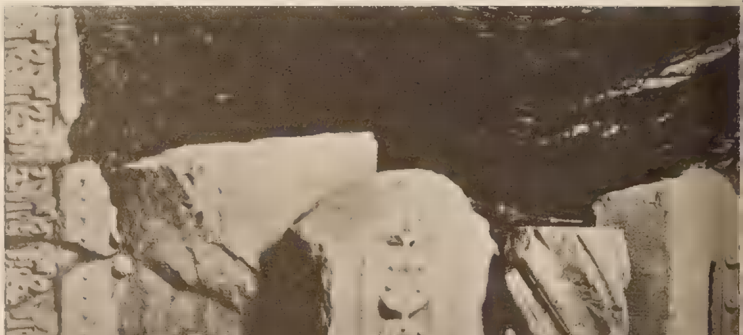
This is 80-screen



This is 133-screen

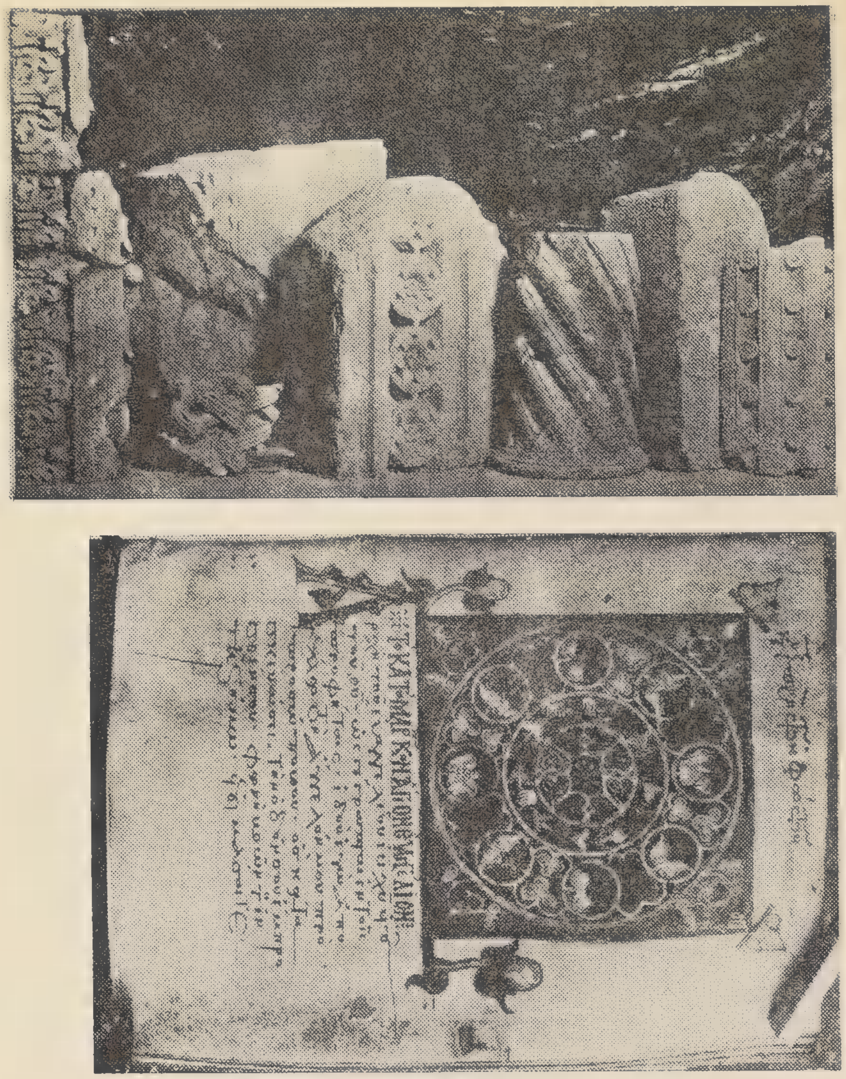


This is 150-screen

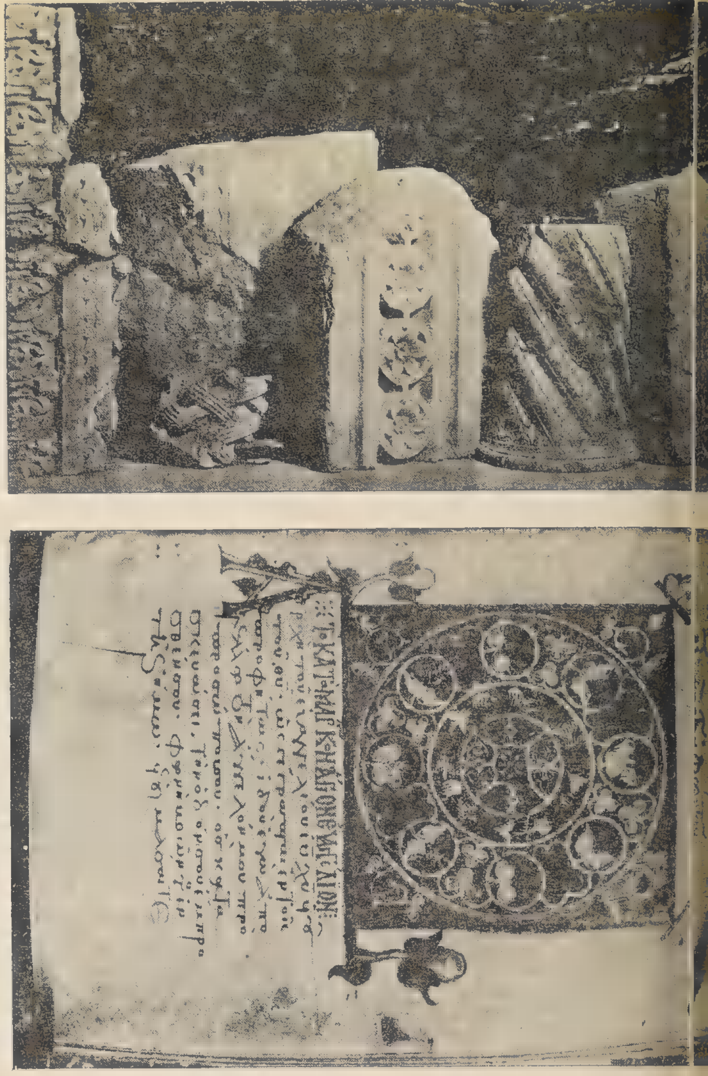


This is 175-screen

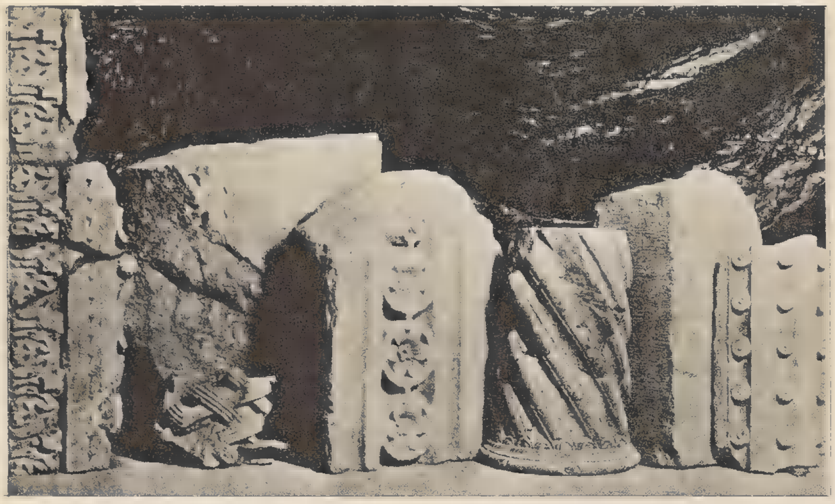
WORK DONE ON ROTAPRINT



This is 80-screen



This is 133-screen



This is 150-screen

This is 175-screen

WORK DONE ON MULTILITH
FIGURE XLIII

manufacturers of these presses make various claims as to the quality of their products. To lay the matter objectively before the reader, the Joint Committee has taken two photographs--an archeological picture and a manuscript--and had them both screened at 85, 133, 150, and 175 lines to the inch. This negative, with its four different screenings, was then run on the rotaprint (Figure XLII), the multilith (Figure XLIII), and the Harris press (Figure XLI). The differences between fineness of screening can be noted by comparing, on the same page, the first and last reproductions; the differences in presswork, and presumably in efficiency of the press, are detected by comparing a reproduction in one screening on one press with the reproduction in the same screening on another press.

Photogelatin or Collotype

In the reproduction of half-tone pictures, there is an alternative to the use of the optical illusion produced by the arrangement of dots on a white background. The ink itself may be laid on the paper in a surface of varying depth. Anyone who examines a badly printed page of type may observe that some of the letters are lighter than others because the printer has not given the paper an even pressure on the type metal surface; some letters are therefore printed in a lighter tone than others. This same principle of varying the amount of ink that is laid on a paper surface will reproduce half-tones. The two techniques that utilize this principle are photogelatin (sometimes called collotype) and photogravure.

In photogelatin printing, as in dermaprint, the chemical basis of the process is the action of gelatin and a bichromate under the influence of light. A plate of glass or metal that has been ground to give it a tooth is covered with gelatin that has been made light-sensitive by being treated with ammonium bichromate, and is rapidly dried with heat. The rapid drying leaves the gelatin in a state of strain. It is ready, on the slightest provocation, to crackle like the paint on a badly painted surface. This crackling is called "reticulation." At this point photography intervenes.

The sensitized gelatin-covered plate in exposed to light in a vacuum printing frame through a photographic negative. The transparent parts of the negative (i.e., the ones which will print black in the finished copy) allow the light to tan the bichromated gelatin; the dark parts of the negative leave the gelatin untanned. When the plate is then developed in water, the gelatin crackles or reticulates, because the tanned gelatin on top resists the expansion of the soft gelatin below. This cracked surface has a crepelike formation with more reticulation in the high lights and less in the shadows. This grain in photogelatin is much finer than the grain of a highly screened photoengraving. Moreover, the photogelatin plate does not exhibit, like the photolithographic plate, a sharp distinction between the parts that will take ink and those that will not. The amount of the tanning effect upon the gelatin and the degree of reticulation show continuous gradations from those parts of the plate that have received most light to those that have received least.

When the photogelatin plate has been exposed and developed, it is moistened with a mixture of glycerine and water before being inked. The glycerine-water mixture does two things: first, it swells the untanned parts of the gelatin surface so that they rise slightly higher than the tanned and reticulated parts. This permits the ink to lie more heavily in the parts of the plate that have received most light during exposure under the photographic negative. Because of this slight difference in height of printing surface, the process is sometimes called an intaglio process.

The second thing done by the glycerine-water mixture is more in line with photolithographic principles. Since the raw glycerine absorbs more moisture than the tanned gelatin, it is less receptive to ink. The soft gelatin acts like the moistened metal surface of the photolithographic plate, taking water and rejecting ink. The supply of moisture on the gelatin is not replenished from any water roller, but from the air. The glycerine picks up the moisture from the air.

The photogelatin plate will not make as many impressions as the photolithographic plate. When the gelatin is laid on glass, it lasts for about 3000 impressions; when laid on aluminum, for 5000 to 10,000 impressions. Because of the short life of the plate, the photogelatin process is not suited to long runs.

In the photogelatin technique, photographs are reproduced without screening. This fact may result in lower costs than would appear in photoengraving or even in photo-offset of screened photographs.

Another peculiarity of the photogelatin technique is the ability to reproduce pictures printed as photoengravings. It is very difficult to make a new screened photoengraving from a published half-tone, because the light from the aggregation of dots in the half-tone does not behave in the screening like light from an original photograph or wash drawing. If an author wishes to use from a published book a photoengraved illustration, he can secure a much more accurate copy with the photogelatin technique than with the photoengraving or photo-offset technique. In a series of history books, The Rise of Modern Europe, the firm of Harper Brothers used photogelatin for the reproduction of illustrations. The use of this process has made it much easier than it would otherwise be to gather the illustrative material, because pictures could be copied without going back to the photographs from which the photoengraved prints were made.

The presses used in the photogelatin process are of two types: the rotary presses, taking large flexible metal sheets (usually aluminum); and the flat-bed presses, which use a thick sheet of glass. The dimensions of these presses vary. The Continental Lithograph Corporation of Cleveland has rotary presses 44" x 64"; the Meriden Gravure Company of Meriden, Connecticut, uses a flat-bed press 28" x 39".

The principle explained in connection with the photo-offset process, that that format is least costly which uses the largest proportion of the available printing surface area with least wastage, applies equally to photogelatin.

The photogelatin process, primarily used for illustrations either in book publications or in posters, could be adapted to the reproduction of textual matter. There is no technological obstacle to the preparation of copy for the photogelatin process in the form of typescript text and unscreened photographic prints or negatives. Two full-tone collotype reproductions are shown herewith (Figure XLIV, XLV). Note also the enlargement of microcopied print in Chapter XI, Exhibit LXIII.

The limitation imposed upon this process by the rapid wearing out of the printing surface has influenced the use of the process commercially. But this limitation is more like an advantage when the process is considered in connection with the reproduction of research materials, for the accountancy and trade practices of the photogelatin shop have adapted themselves to the short runs that are common to all research publications.

Intaglio Processes: Photogravure

All intaglio printing processes use a metal plate in which shallow depressions receive ink, which is then transmitted to paper, making a darker tone where the depression is deepest, and a lighter tone where the depression is slight.

The photogravure process is a photochemical intaglio technique. A smooth sheet of copper is first given a very fine dusting with powdered asphaltum or resin. When this fine dust is baked on to the plate it furnishes a protective grain, comparable to the grain that appears in the photogelatin process when the gelatin reticulates under the influence of the light.

Then a film of bichromated gelatin is laid on the copper plate and printed on the same principle as that which is used in the photogelatin process, except that in this case it is printed from a positive photograph instead of a negative. The light therefore hardens the gelatin in those parts of the picture that are to be light, and leaves it soft in those parts of the picture that are to be dark. The copper plate is then put into an acid bath, which quickly eats away the soft gelatin and gets to work on the copper; but its action on the copper is slower to the degree that the hardening of the gelatin (as an effect of light) has slowed it down. Thus the copper plate will emerge from the process with depressions that are deepest in those areas which correspond to the dark places in the positive photograph and slightest in the places that correspond to the light places in the original photograph.

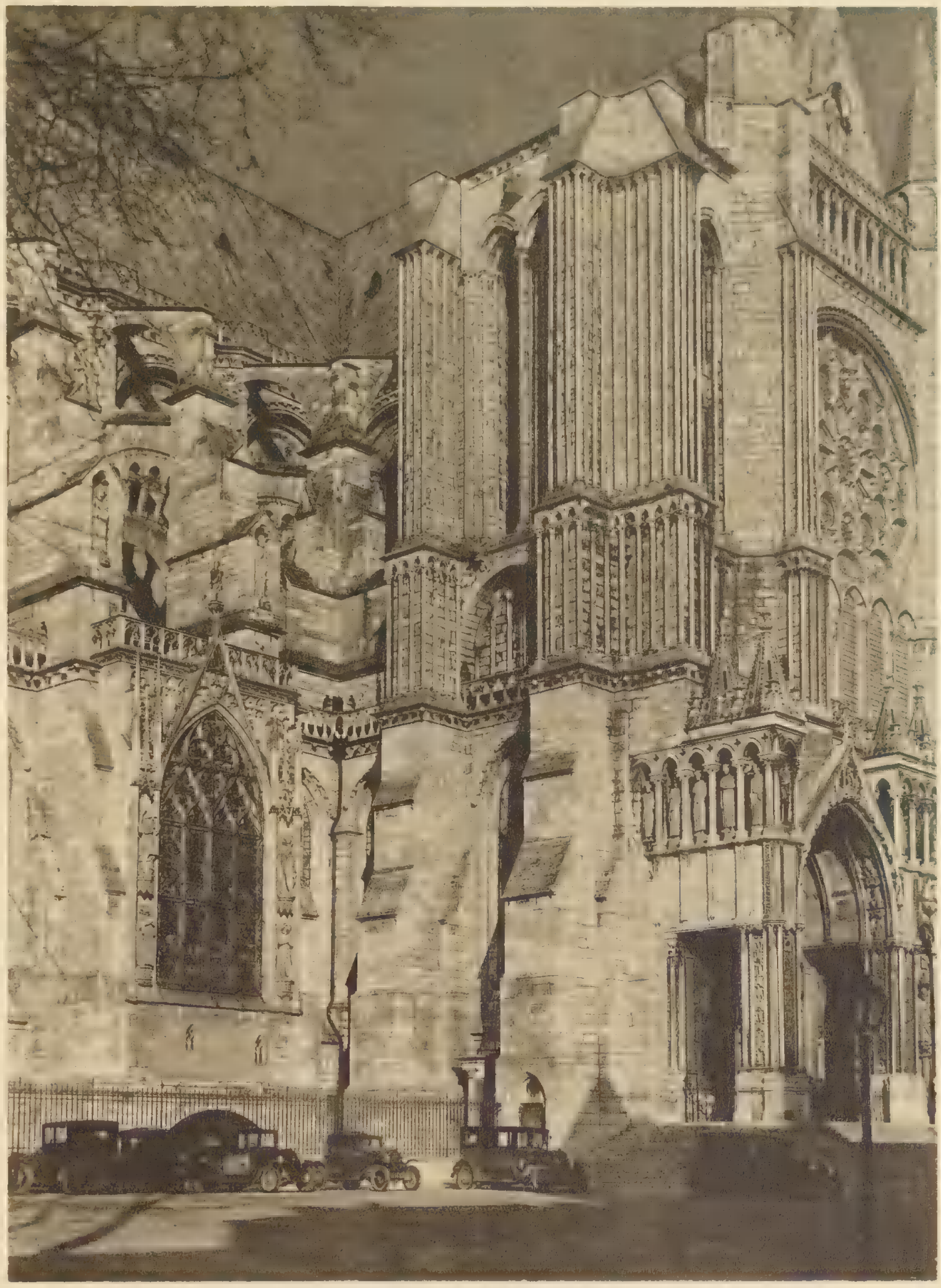


FIGURE XLIV

Note fine treatment of lighter shades.

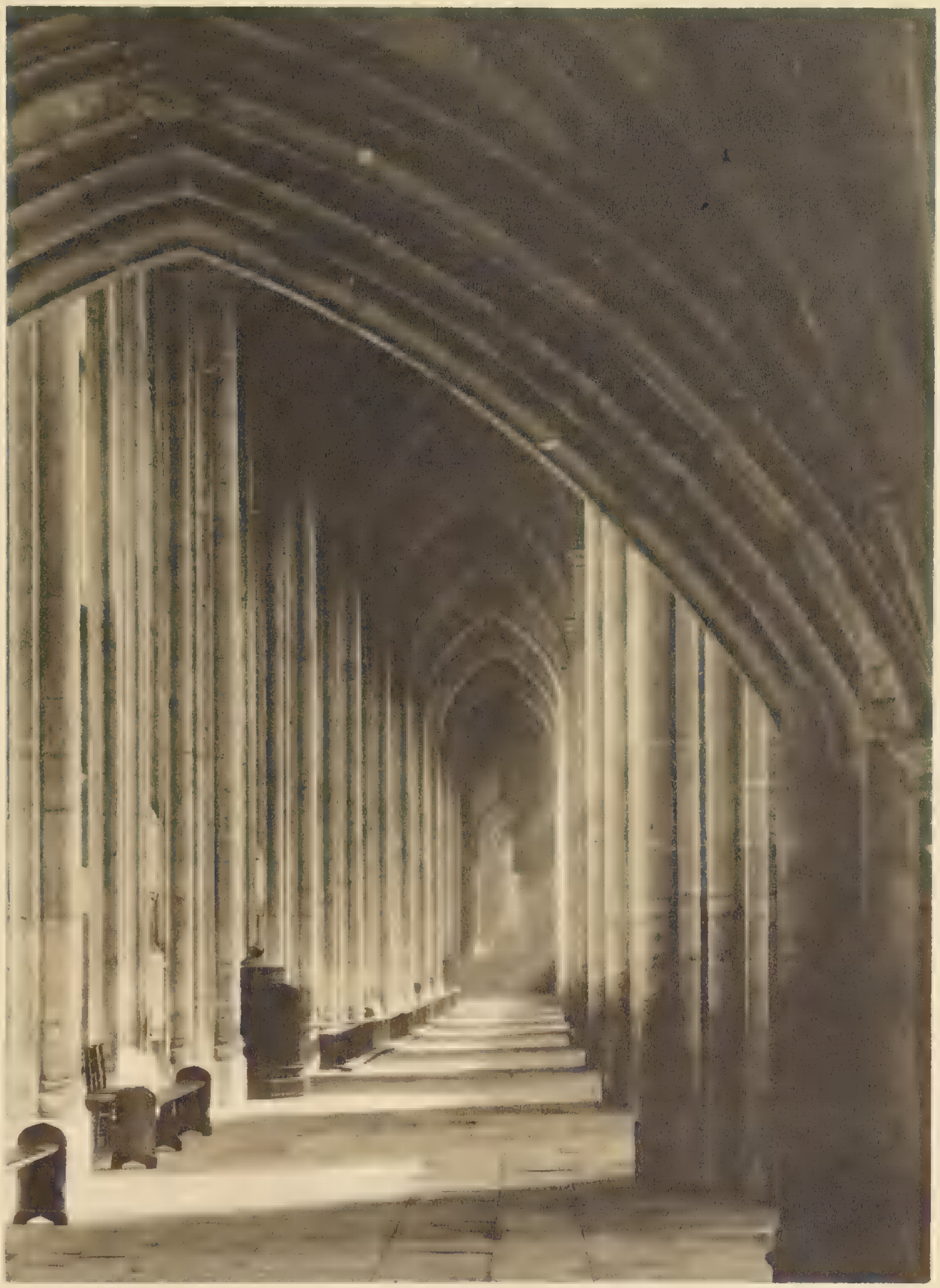
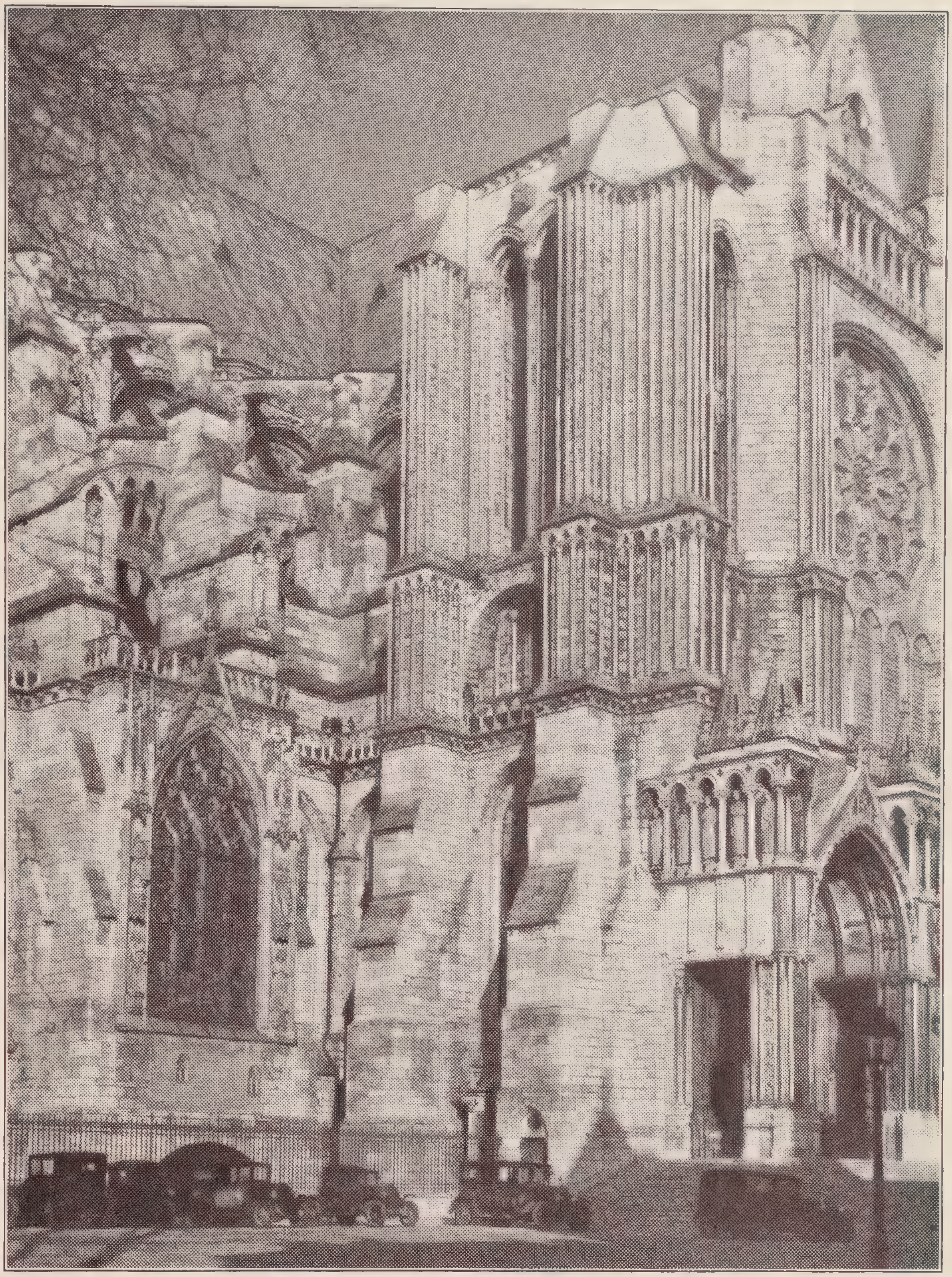


FIGURE XLV

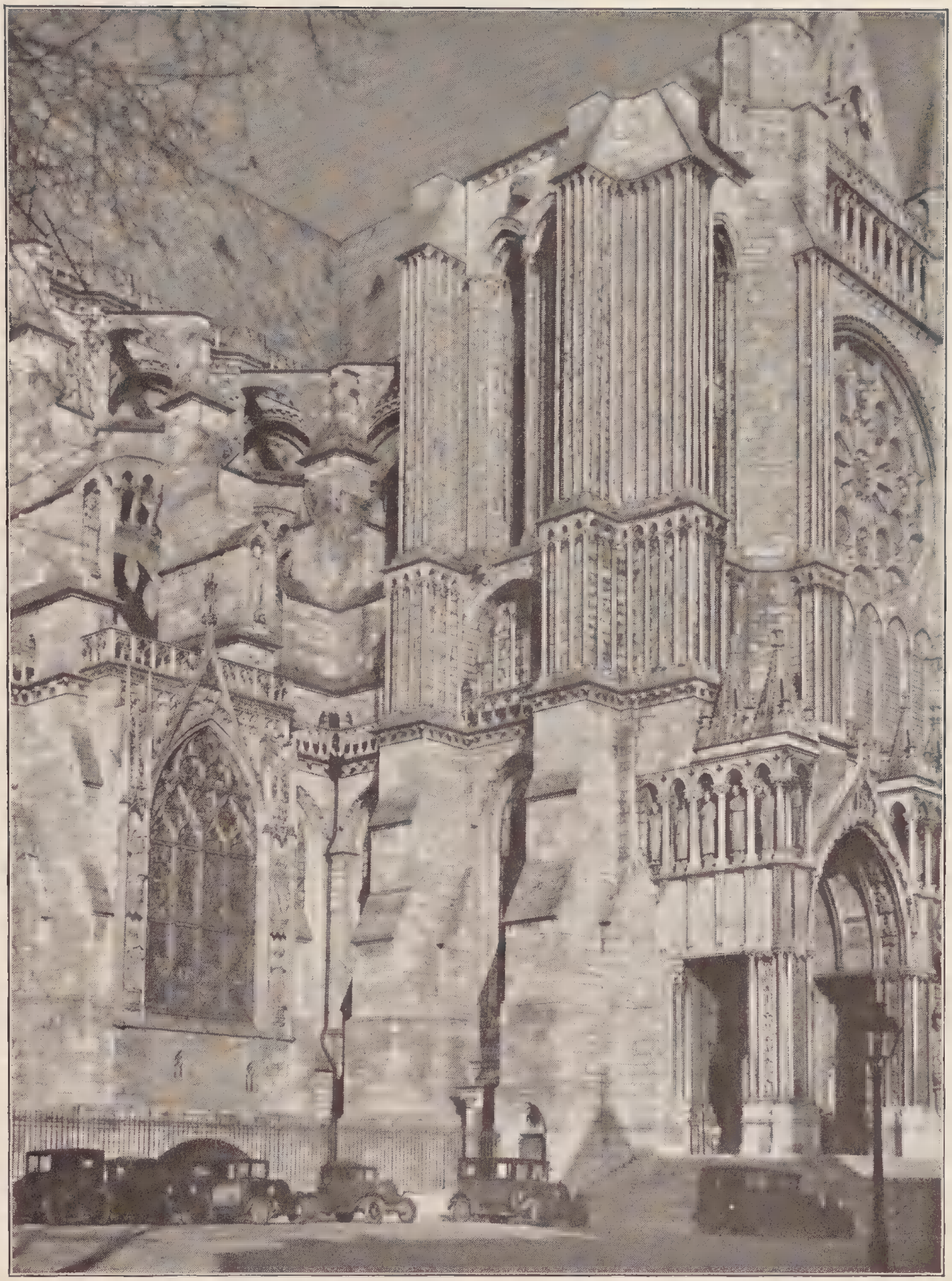
Note lack of resolution in darker shades, but fine gradations in lighter shades.

FIGURE XLVI



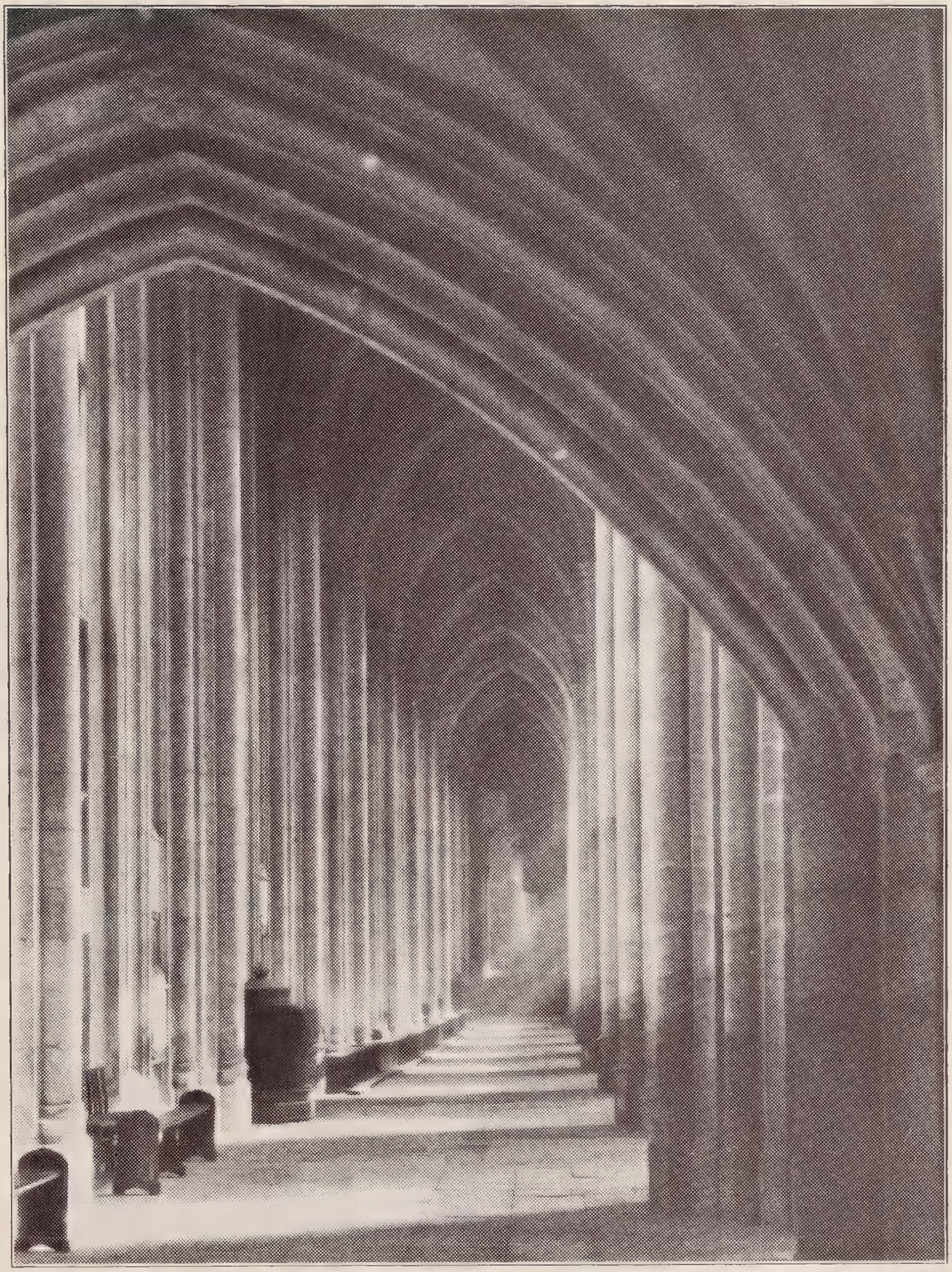
Zinc half-tone screened at 80 lines to the inch. The loss in the rendering of detail, as compared with the 133 screening (FIGURE XLVII), can be seen in the statues, windows, and automobiles.

FIGURE XLVII



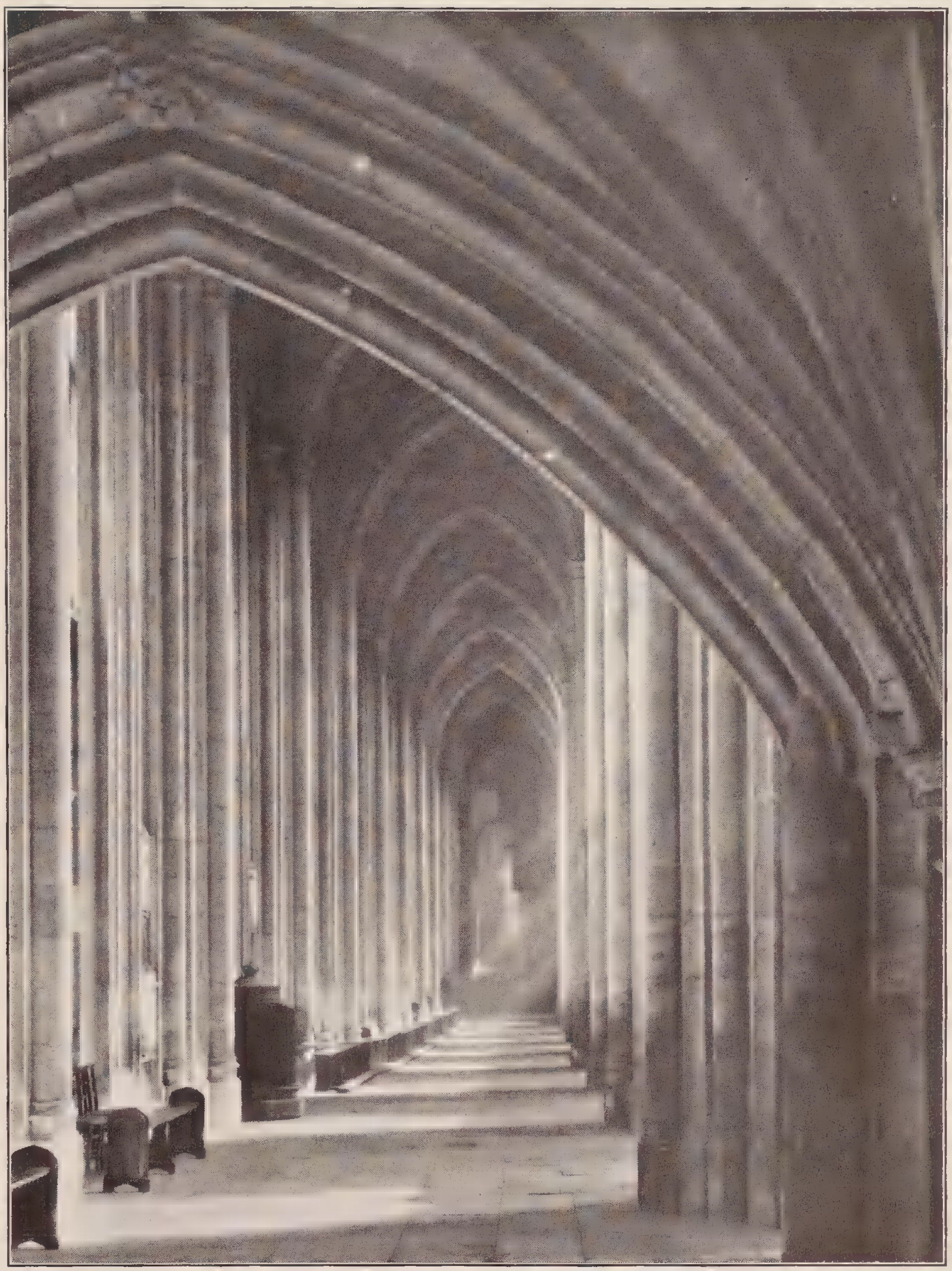
Copper half-tone screened at 133 lines to the inch. The gain in the rendering of detail, as compared with the 80 screening (FIGURE XLVI), can be noted in the statues, windows, and automobiles.

FIGURE XLVIII



Zinc half-tone screened at 80 lines to the inch. Compare the flat rendering of shadows in the vaulting with the higher screening (FIGURE XLIX), and note also the finer detail of light and shadow in the higher screening.

FIGURE XLIX



Copper half-tone screened at 133 lines to the inch. Note the resolution of the darker shades in the vaulting as compared with FIGURE XLVIII.

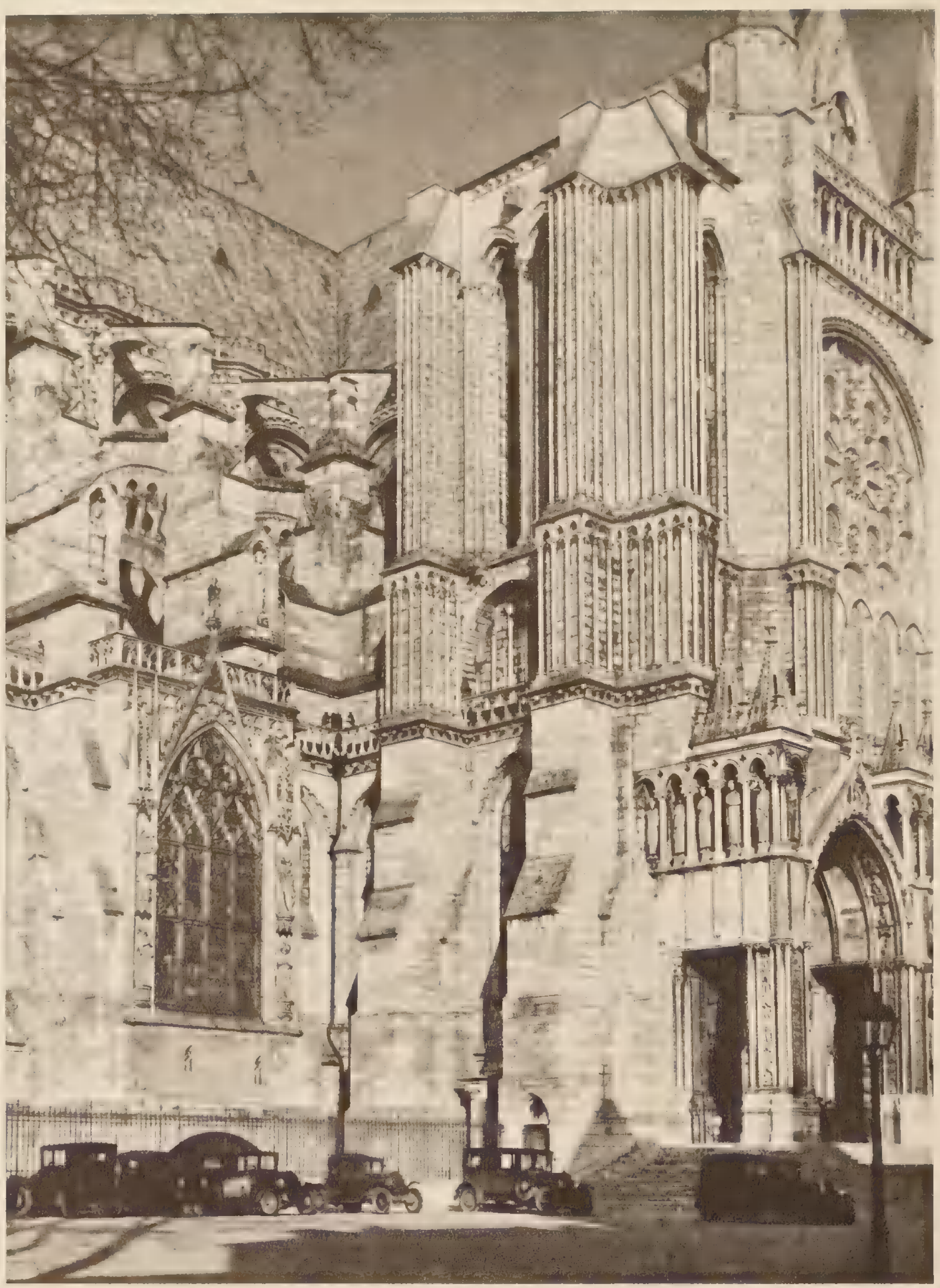


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FIGURE L

Note accurate rendition of fine details

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EDWARD STERN & COMPANY, INC.
PHILADELPHIA, PA.

One of the advantages of the photogravure method over others is the ease with which the plate can be retouched by hand. The shadows can be darkened, for instance, by deepening the depressions in the copper.

Aquatone and Pantone

Two variants of the photo-offset process should be mentioned at this time. One of them is the aquatone process, a planographic process that produces remarkably faithful reproductions of photographs from a gelatin plate. It is not a widely used process, Edward Stern and Company, Inc., of Philadelphia being the only establishment the author knows of that does this kind of work,[2] but it makes very fine reproductions. It has many similarities to the photogelatin method. An example of aquatone work is displayed herewith (Figure L).

The aquatone plate is made of a thin sheet of zinc. Edward Stern and Company, Inc., uses a 45" x 54" plate for its presses. To furnish a base for the gelatin coating, the zinc sheet is "grained" with quartz; the gelatin is then applied, set, and washed in a hardening solution. For further hardening, the plate is baked to 200° F. A bichromate sensitizer is used to make the gelatin light sensitive, and then the plate is put in a printing frame in contact with the illustration it is desired to reproduce.

The illustration to be reproduced, which has been stripped onto a sheet of glass, is pressed into close contact with the plate, and the printing is accomplished by exposure of the sensitive plate to a strong arc lamp. The light makes the sensitized gelatin which has been exposed become impervious to water and alcohol. When the printing stage is passed, water and alcohol are used to develop the plate; this water and alcohol solution removes the unaffected bichromate and leaves a positive image. A second baking toughens the gelatin and gives it a longer life on the press. The plate is now ready to be run.

During all this preparatory work, cleanliness, controlled temperature conditions, and precision are essential for good results.

The plate is fastened to a cylinder and fed water during each revolution by a water roller. The average plate runs about 20,000 impressions, but a run of 30,000 or more is quite possible. Only the gelatin that has not been affected by the light will absorb the water; therefore, when the ink rollers come into contact with the cylinder, the ink is repelled by the dampened gelatin and attracted by the dry positive image. The rubber blanket cylinder, receiving the ink that has been deposited on the plate, comes in turn in contact with the impression cylinder and brings the paper into position for receiving the ink impression.

Offset paper with a very hard rough surface is best suited for aquatone work.

The cost of aquatone work compares with that of fine offset work.

The second variant is the pantone or mercury process. Pantone is a complicated process designed to make use of a principle similar to that of photolithography to prepare a printing surface which will stand long runs and be very resistant to wear. It makes use of the fact that chromium is a hard metal which will accept and transfer ink, while mercury will refuse ink. The chromium serves instead of the grease of primitive lithography; the mercury takes the place of water on the wet surface of the stone.

Although this process is not useful in cheapening small editions, it is interesting as an illustration of the variety of techniques which can be used in printing. A sheet of iron is coated with a thin surface of copper and a very thin surface of chromium on top of the copper, and then a photographic emulsion on top of the chromium. The text is transferred to the plate in the usual photolithographic method, and the parts of the metal which ordinarily receive water are etched with acid through the chromium to the copper. Silver is then deposited on the plate and adheres to the copper but avoids the chromium. The mercury is rubbed over the plate, and the mercury amalgamates with the silver.

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2. Edward Stern and Company, Inc., has made available an excellent booklet, "What Is Aquatone?" which gives a detailed description of the process.

The result is an all-metal plate which will print without using the raised-type principle. Related processes are the Renck and Porte methods.

Some efforts have been made to use the mercury process for combining the photolithographic principle with the mechanics of the flat-bed press. The process is also used with the offset press. It has no immediate practical importance in connection with the problems of reproducing research materials.

Dermaprint

The dermaprint stencil method has been described in connection with the reproduction of out-of-print books. It is the coarsest of the multiplying techniques that utilize the photographic principle. The dermaprint stencil will reproduce line drawings, but in the reproduction of screened pictures it will take only the coarsest screens. Dermaprint screening is not even as fine as the screening used in newspaper work.

Photosensitive Paper Processes

Illustrations can be copied by the various blueprinting techniques, by photostat, and by photographic printing on bromide paper. The differences in quality are not unlike those differences that appear in the other techniques: they are differences in the accuracy in the rendition of detail, and differences in faithfulness in the reproduction of tones. The so-called "soft" bromide papers give the widest range of tones; hard bromide papers and photostat papers offer a much reduced range, and the blueprint types of paper offer even less tone variety. The variation in accuracy in the rendering of detail is the same: the bromide prints are most accurate and the blueprints least accurate. The costs naturally are in reverse order.

In making cost comparisons, two types of material should be distinguished: those requiring only black-and-white contrast and those requiring half-tones.

Cost Comparisons

The starting point of cost comparisons must be a picture of a given area reproduced in editions of varying size. The dimensions of the picture chosen for this first comparative table are 4" x 6" because a picture of this size can be used in an ordinary octavo book 6" x 9". It is assumed, moreover, that 100 illustrations of identical size are required. The book here described is, therefore, a book of 100 pages of pictorial material, consisting of 6" x 9" pages with pictorial matter 4" x 6" on each page.

This crude comparison indicates that in size of edition the processes that operate by diminishing costs (photo-offset, photoengraving, photogelatin, photogravure) begin to become cheaper than the processes involving more constant costs (blueprint, photostat, bromide photographs) when the edition is between 50 and 100 copies. But there are a number of other variables to be considered. These variables relate both to cost conditions and quality conditions.

One variation in cost conditions has to do with the number of different pictures reproduced. If the specifications called for the reproduction of only one or five or twelve pictures instead of a hundred, would there be a substantial modification of the cost relationships that appear on the foregoing table? If the pictorial matter were in larger pictorial surfaces or smaller pictorial surfaces, would the processes still stand in the same cost order?

The information needed to answer these questions accurately is not at hand. There are, however, certain concrete quotations which can be set down and then compared in so far as they are comparable. All the diminishing cost techniques are represented, for quotations have been given by a firm specializing in photogravure and a firm specializing in photogelatin, and photoengraving prices are highly standardized. These quotations are taken to cover different sizes of picture and different sizes of page, according to the table on page 92.

Combination of Pictorial and Textual Matter

The full complexity of the cost analysis of the reproduction of pictorial matter does not appear until allowance is made for the different ways in which pictures may be combined with text.

The simplest situation is that of the photo-offset book illustrated with black-and-white drawings, charts, or maps.

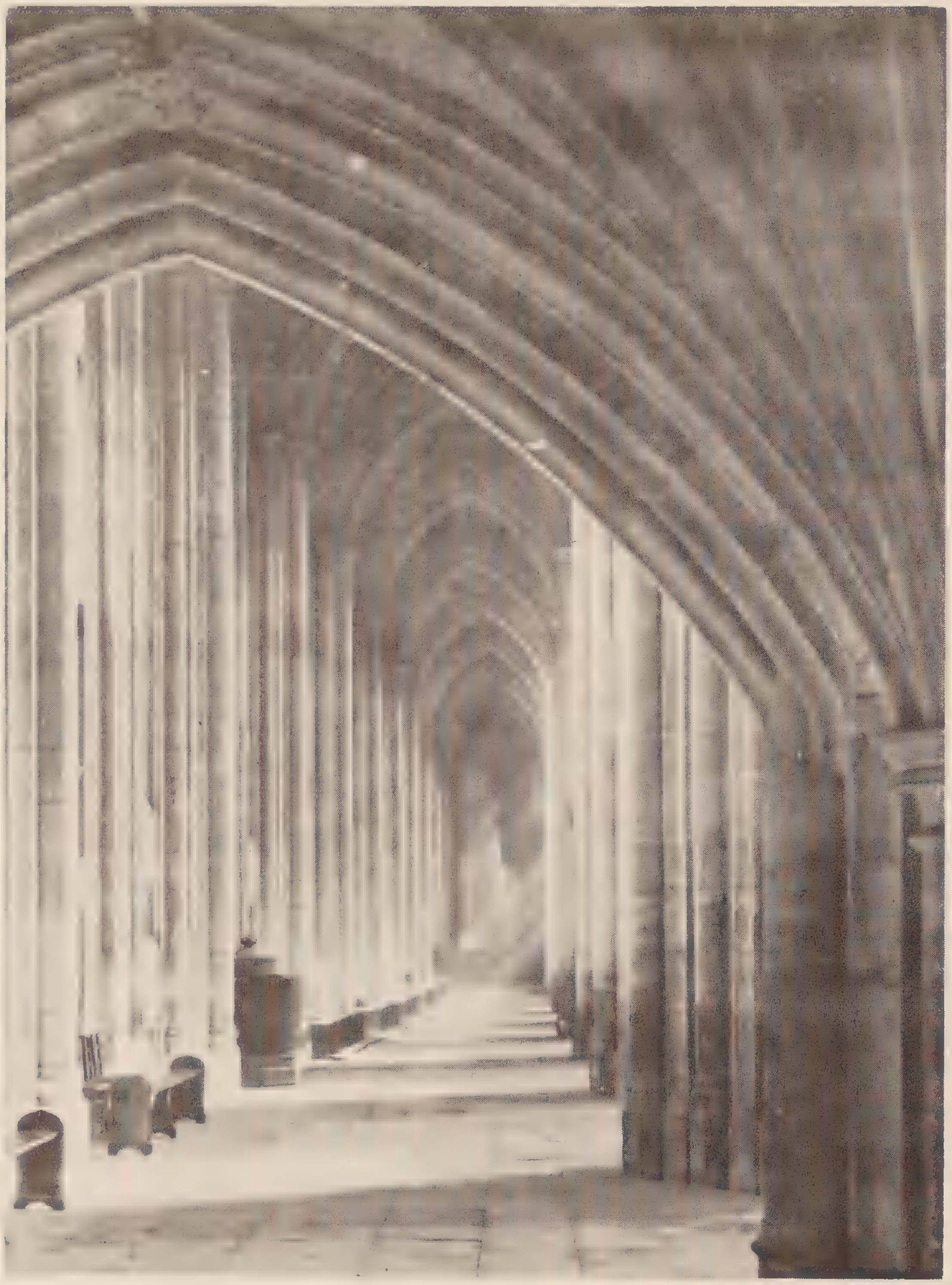

FIGURE LI
Photo-Offset Halftone
(120 lines to the inch)
Geoffrey Landesman, Photographer

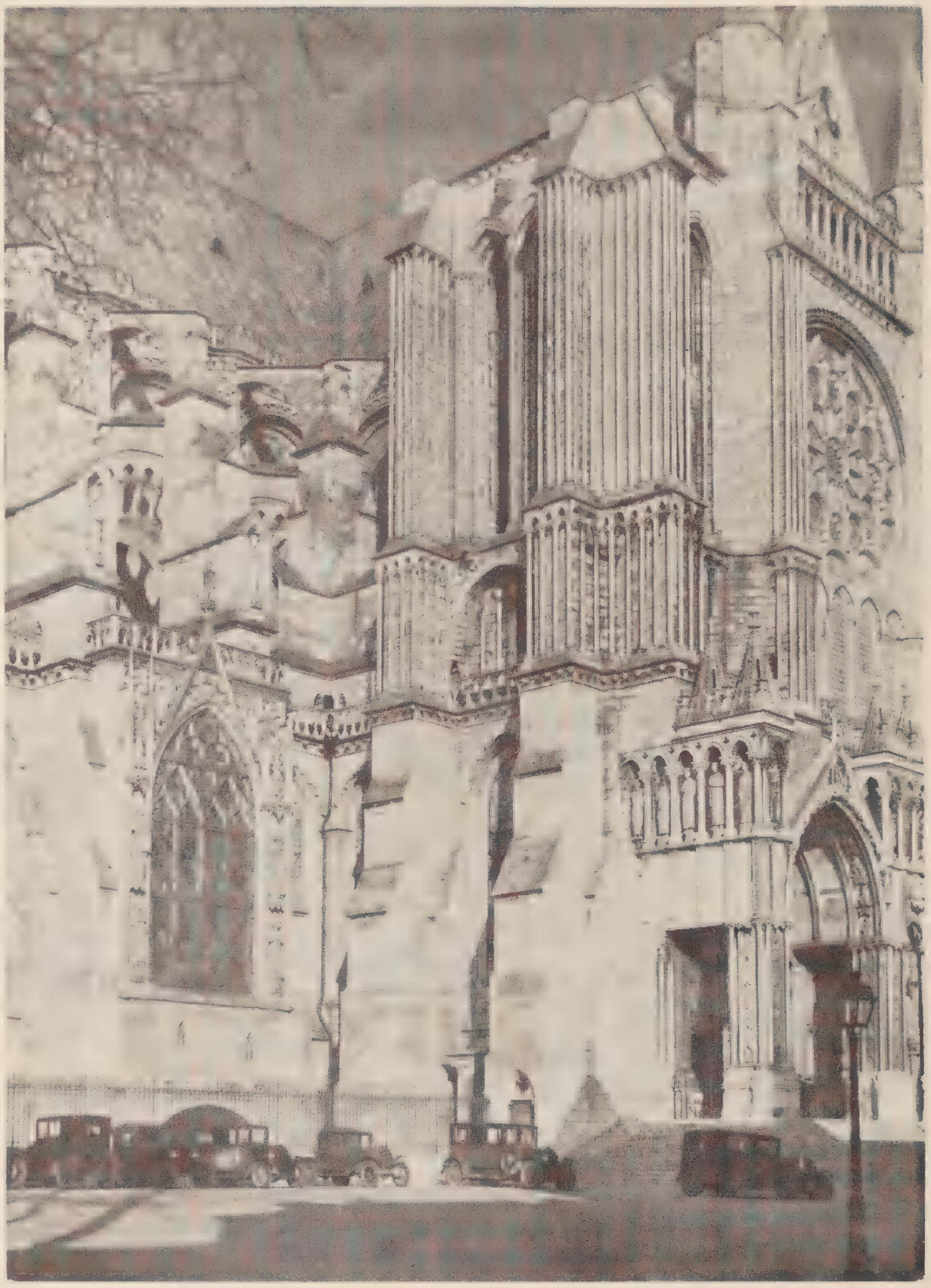

FIGURE LII
Photo-Offset Halftone
(120 lines to the inch)
Geoffrey Landesman, Photographer

TABLE XXXI

COST, EXCLUSIVE OF BINDING, OF A BOOK OF 100 PAGES 6" x 9", EACH PAGE CONTAINING PICTORIAL MATTER OF SIZE 4" x 6"

Process	Edition						
	10	25	50	100	250	500	1000
Blue line print from paper negative	$41.50	$ 70.00	$117.50	$212.50	$ 497.50	$ 972.50	$1922.50
B-W	19.00	47.50	95.00	190.00	475.00	950.00	1900.00
Photostat (8 upon 18 x 24)	90.00	202.50	390.00	765.00	1890.00	3765.00	7515.00
Photo-offset black-and-white (includes saddle wire stitching)		135.00	140.00	144.00	152.00	167.00	193.00
Photo-offset half-tone (includes saddle wire stitching)		360.00	365.00	369.00	377.00	392.00	418.00
Zinc line cut				100.38	120.38	147.88	205.38
Zinc photoengraving, screened 100				99.70	119.70	147.20	204.70
Copper photoengraving, screened 150				102.50	122.50	150.00	207.50
Photogelatin (collotype)				350.00	535.00	780.00	1150.00

Here the pictorial material is simply combined with the format copy, and no further effect upon cost is felt.

Whenever pictorial material is to be combined with relief printing, the cost of fitting the type around the photoengraved blocks must be met.

When half-tone work is combined with text in photo-offset the cost of the screening must be added to the normal cost of photo-offset book production.

Consider the situation of an author who has written a book and wishes to illustrate it. He has gathered as illustrations either drawings or photographs. The photographs may be original prints or copies from printed photoengravings. He now wishes to determine the process to be used in publishing.

If his edition is to be less than fifty, he will probably fare best if he makes up a typescript book by one of the processes and in one of the formats discussed in Chapter V, and then has the photographic material duplicated by a blueprint or bromide-print process. In binding his book, he will simply gather the illustrative sheets with the typescript pages and have them bound in place.

If the edition is larger, he may wish to take advantage of the law of diminishing costs in larger editions and to set up his book for reproduction by printing, photo-offset, or photogelatin. He will then wish to decide whether the illustrative material should be fitted in with the text or reproduced as separate pages. The variables are so numerous that it will not be possible to set forth here the definite costs that may be involved in any decision.

The most important distinction must be made between the drawings, which are to be done in black and white, and the tone pictures, which must be reproduced to show the intermediate tones. The next most important decision lies between publication of illustrations on separate pages or on the same pages with the text.

TABLE XXXII

COSTS OF REPRODUCING BOOK OF PICTORIAL MATTER IN VARYING PAGE AND PICTURE SIZES

Page Size	Picture Size	No. of Pages at a Time			
6" x 9"	4" x 6"	8			
8" x 10"	5" x 7"	4			
10" x 12"	7" x 9"	4			
11" x 14"	9" x 11"	4			
		Edition of			
		100	250	500	1000
4" x 6" picture 6" x 9" page	Line cut, zinc	100.38	120.38	147.88	205.38
	Half-tone, zinc	99.70	119.70	147.20	204.70
	" " copper	102.50	122.50	150.00	207.50
	Collotype	350.00	535.00	780.00	1150.00
5" x 7" picture 8" x 10" page	Line cut, zinc	101.17	121.17	148.67	206.17
	Half-tone, zinc	100.47	120.47	147.97	205.47
	" " copper	104.20	124.20	151.70	209.20
	Collotype	550.00	885.00	1325.00	2000.00
7" x 9" picture 10" x 12" page	Line cut, zinc	103.14	123.14	150.64	208.14
	Half-tone, zinc	102.39	122.39	149.89	207.39
	" " copper	108.33	128.33	155.88	213.33
	Collotype	1000.00	1670.00	2550.00	3900.00
9" x 11" picture 11" x 14" page	Line cut, zinc	106.04	126.04	153.54	211.04
	Half-tone, zinc	106.39	126.39	153.89	211.39
	" " copper	113.57	133.57	161.07	218.57
	Collotype	1100.00	1770.00	2650.00	4000.00

For the drawings the author has two choices: he may elect relief printing with zinc line-cuts, or photo-offset from typescript. For the toned illustrations, he may choose photoengraving with printing, photo-offset from typescript with screened illustrations, or photogelatin.

Note that in all these processes the stage in book production is reached after which the presence of illustrative material adds nothing to costs. In the printing process this stage does not arrive until the entire first cost is met and the press is ready to run; in the case of photo-offset of drawings, or photogelatin of drawings or half tones, the stage is reached when the photographic negative is trued up; in the case of photo-offset of half tones it is reached when the screening is completed. The whole process of etching on metal and fitting metal to type is a part of a relief-printing cost, but not of a photo-offset or photogelatin cost.

If the area cost of photogelatin work were the same as area cost of photo-offset, this process would be indicated for all combinations of photographs with text. Since the prices for this process are not highly standardized, an accurate table indicating the amount of screened photography in relation to the amount of text that would make photogelatin the favored process cannot be made. But the conclusion will probably stand that if the amount of text (i.e., the page area covered by text) is small enough in comparison with the area covered by pictorial matter, photogelatin will stand out as the best technique for the reproduction of an illustrated work.

It must be emphasized again that in

the reproduction of illustrations, as in all cases where area costs predominate, the costs are increased as the size of the illustrations is increased, and diminished as their size is diminished. The alternatives confronting the author in this case are the same as those which confront him in the reproduction of the text itself, whether it is a reprint of an out-of-print book or a typescript book reproduced by photo-offset: he can always cut costs by sacrificing size, and with size, beauty and legibility.

There is another way in which pictorial and textual matter may be combined. The pictorial matter may be separately printed and then combined with the textual matter in the course of the bookbinding process.

The effect of this method of combining text and picture is to convert it into a running cost, for the cost of binding varies almost directly with the number of copies bound, and the cost of inserting extra pictures of sheets while gathering the folded pages of a book varies almost directly with the number of copies and the number of insertions per copy.

It is not excluded that the author should have recourse to microcopying to lay illustrative material before his reader. A text might be issued in an edition of appropriate size, and the illustrative material to go with it reproduced as a strip of film, to be used by projection on a screen or in a reading machine. The cost levels at which such films can be manufactured and distributed will be discussed in Chapter XII; it need only be noted at this point that the technique is at hand, and that it might lead to a practice of far more copious pictorial illustrations than the scholarly world has as yet dreamed of using.

Summary

The reproduction of pictorial matter, like the texts, can be accomplished at costs varying over a wide range and permitting sales at normal prices or prices not greatly in excess of normal, in editions varying through all the ranges of the possible scholarly market, from that which is presented by the few largest research libraries to that which just falls short of the requirements of the commercial publisher.

That which is usually spoken as the "cost" of publishing a book, whether illustrated or not, whether in ordinary Roman characters or not, is only a special instance of a great range of possible costs. It is usually the cost of applying a relief-printing technique to the distribution of an intellectual product to a non-commercial market. The difference between the probable income from a full, normal, commercial market and the anticipated income from an actual scholarly market is usually made up as a subsidy to the press, which has made no technological concessions to the situation. The press publishes as if the book were to be sold to 2000 or more buyers and asks the sponsors of the publication to relieve it of the financial consequences of proceeding on this fiction.

True it is that scholars are not yet accustomed to books in typescript, illustrations in blueprint, nor to many of the varieties of product that technology now puts at their disposal. If they can but accommodate themselves to the new techniques, important barriers to intellectual intercourse can be made to fall.

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TABLE XXXIII

ANALYSIS OF PRODUCTION COSTS OF ILLUSTRATIONS COMBINED WITH TEXT

<table>
<tr><th rowspan="2">Stages in Manufacture</th><th colspan="2">Text with Line Drawings</th><th colspan="3">Text with Toned Illustrations</th></tr>
<tr><th>Printing</th><th>Photo-offset</th><th>Printing</th><th>Photo-offset</th><th>Photogelatin</th></tr>
<tr><td>Composition of Textual Matter</td><td>See Chapter III on linotype or monotype</td><td>See Chapter V on typescript</td><td>See Chapter III on linotype or monotype</td><td>See Chapter V on typescript</td><td>See Chapter V on typescript</td></tr>
<tr><td colspan="6">Truing up the Illustrative Material: reducing or enlarging photographs to bring them to proper scale. This step in the process is common to all techniques. The author can assume it himself by having all the drawings or photographs in such a size that they can be reproduced in the same degree of enlargement or reduction. A discount of 10% to 30% is usually accorded in quotations on a job that does not call for special truing up of photographs, or one that has all photographic work reproduced in size as submitted, or in the same degree of reduction or enlargement. This discount applies only to plates which scale at less than $5.62 if half tones; $4.28 for zinc etchings.</td></tr>
<tr><td>Screening of Illustrations</td><td>Not necessary</td><td>Not necessary</td><td>Screening is about 40% of the cost of a photoengraving plate</td><td>Screening process is technically identical with that used in photoengraving; prices are not so highly standardized</td><td>Not necessary</td></tr>
<tr><td colspan="6">Making Photographic Negatives: apart from the screening, this element in the process is identical for all techniques, but trade practice has standardized the use of the wet plate in photoengraving, while the photo-offset operators utilize film or paper, which is cheaper.</td></tr>
<tr><td>Making the Printing Surface</td><td>Zinc line cuts, $5.38 standard price for one 4" x 6" cut</td><td>Illustrative matter and text receive same treatment in preparation of printing surface; cost is simple area cost. See Chapter III</td><td>Copper plate engraving $7.55 standard price for a 4" x 6" cut</td><td>Illustrative matter and text receive same treatment in reparation of printing surface; cost is simple area cost. See Chapter III</td><td>Illustrative matter and text receive same treatment; trade has not developed the production of typescript texts with photogelatin illustrations, but there are no technological obstacles</td></tr>
<tr><td>Setting the Printing Surface in the Press</td><td>Make-up more costly if line cuts and text fitted on same page</td><td>Illustrative matter and text receive same treatment</td><td>Make-up more costly if cuts and text fitted on same page; make-ready more expensive in the higher screenings</td><td>Illustrative matter and text receive same treatment</td><td>Illustrative matter and text receive same treatment</td></tr>
<tr><td colspan="6">Running Costs: are not affected by the presence or absence of illustrative material with the text.</td></tr>
</table>

CHAPTER VIII

A STUDY OF PAPER PERMANENCE

This chapter has been subjected to criticism by the Bureau of Standards, and the Permanence and Durability Committee of the Technical Association of the Pulp and Paper Industry. The latter body contested certain conclusions of the paper as originally submitted and has expressed a wish that the chapter be published as amended by them, if it is to be published with their approval. Comments and controversial material, therefore, which had been written in the original draft of this chapter and revised out of it, have sometimes been inserted here as footnotes; the substance of the chapter as it stands without the footnotes has been issued separately as a report of the Technical Association of the Pulp and Paper Industry.

The outstanding qualities required of a book paper are four: printing surface, opacity, strength, and permanence and durability. Other qualities of a greater or lesser importance are color, feel, formation, aesthetic value, etc., depending on the purpose for which the paper is to be used. The printability, opacity, and strength qualities of book paper can be determined by suitable testing instruments and expressed in numerical terms. The fourth outstanding quality, namely, permanence and durability, is not as easily expressed. Permanence of a paper has been defined as the degree of resistance towards the degrading chemical action of the impurities in the paper or of materials in the surrounding air. Durability is the degree to which the paper retains its original qualities under usage. In a 1933 report from the Bureau of Standards,[1] it was brought out that important factors in the permanence and durability of book papers are the chemical purity of the fibers in the sheet, and the conditions under which the books are kept. Paper from books stored in urban institutions is uniformly more deteriorated than that from identical volumes kept in rural libraries, according to the Bureau of Standards investigation. The much thumbed-over books in the children's department of the public library show the results of wear in use, but there is little doubt that the lasting quality of paper is not only dependent upon its environment but is partly related to the paper itself. This permanence quality, however, is not immediately apparent to the observer. The only absolute test of permanence and durability would require that one should wait to see what happens to the paper in the course of several centuries or until there is positive evidence of deterioration.

In the days when paper was an innovation in Europe, competing with parchment, it was regarded as dangerously impermanent, and there was legislation to prohibit its use in legal documents. Of the books printed in the earlier centuries, enough have endured the effect of time to establish beyond question the permanence possibilities in papers made of the materials then in use. During the period 1875-1910, unpurified or crude fibers, such as ground wood, were frequently used in book papers. The Bureau of Standards, in its report, to which reference has already been made, found that book papers containing appreciable quantities of crude fibers were invariably in poorer condition than those containing rag and chemical wood fibers. The period 1875-1910, therefore, is defined as one in which the paper in books published

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1. Arthur E. Kimberly, and Adelaide L. Emley, "A Study of the Deterioriation of Book Papers in Libraries," Bureau of Standards Miscellaneous Publications, No. 140.

in this period may be quite impermanent. This served to emphasize the importance of the chemical purity of the fibers themselves as a factor in the permanence of paper. At the beginning of the present century, paper technicians were calling attention to the danger of printing on paper containing crude fibers, such as ground wood pulp. The conclusion was drawn at that time that papers had a life expectancy proportionate to the amount of rag stock used in their manufacture.[2]

The distributing trade had little knowledge concerning the problem of paper permanence and durability. The market designations of paper ordinarily in use include size, weight, color, surface finish, and a description of the raw materials from which the paper is made. The raw material may be described with varying degrees of precision. The simplest distinction is that which runs between "rag" and "wood pulp" papers, and those which contain different proportions of both. The rags, however, are not of equal quality. The hardest and most durable fibers are the new unbleached cotton trimmings which are bleached in the paper mill. Then come the scraps left from the manufacture of overalls, "new blues;" then the white rags from wornout clothing from the housewife's rag bag;[3] and, finally, soiled rags of different colors from different sources.[4] The higher classes of rags require less chemical treatment for paper stock and, therefore, yield a more permanent paper when carefully manufactured. The lower classes of rags usually undergo a more drastic chemical treatment before being converted to paper and do not yield as strong or as permanent a paper, although for many purposes it may possess other more desirable properties.[5] The wood used in paper making is also subject to various classifications: there is the distinction between the soft (coniferous) woods and the hard (deciduous) woods. Then there are different processes by which the wood is converted into pulp to receive consideration. First, there is the important distinction between "mechanical wood pulp" (groundwood) and "chemical wood pulp." Newsprint paper, for instance, is chiefly mechanical wood pulp; most book paper is made of chemical wood pulp. By different kinds of chemical treatment the impurities in the wood are removed and a fiber of relatively high purity, compared to a mechanical wood pulp fiber, is obtained. "Soda pulp" is made by digesting wood chips in an alkaline solution, such as sodium hydroxide, and is composed of fibers from hard woods. "Sulphite pulp," on the other hand, is made chiefly from soft woods by digesting the wood chips in a solution of sulfurous acid and calcium bisulphite. The fibers generally possess different properties compared to those made by the soda process owing to their difference of origin. Recently certain additional processes giving further purification to chemical wood pulps have appeared.

Within the past decade or so, some paper users have become dissatisfied with the more or less crude paper specifications and have begun to introduce laboratory procedures in standardizing their paper purchases. The distributing trade has not followed this line of development, however; its interests have been heavily vested in the existing trade practices. Recently some of the larger users of papers, who could establish direct contact with the manufacturers, began to demand and to receive "specification papers." It is reported that about 1% of the finer paper trade in 1928 was on a laboratory specification basis, and that by 1933 this had risen to 10%.

The specifications which were most successfully established were those relating to the physical strength qualities of the paper. Standard physical tests were tearing resistance, bursting strength, tensile strength, and folding endurance. For nearly ten years government specifications for permanent all-rag content papers have carried requirements as to the grade of new rag permitted. In addition, limits as to rosin size and acidity have also been included. Specifications relating to

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2. Despite the fact that the very oldest paper of all--the early Chinese--seems to have been made from grass fibers.
3. "No. 1 old rags."
4. "No. 2 old rags."
5. A paper made directly from raw cotton was being developed in 1934 by one paper company in America. Ramie grass fibers are proposed as another paper-making material, but the writer knows of no firm actually using them.

probable longevity of a paper were not so easily set up but progress is being made in that direction.

The librarians seem to have been the ones who showed the first and greatest desire for permanence in book papers, but they were in a bad strategic position for making their desires effective. They were many times removed from the paper manufacturers; they had little influence on the publishers and none on the paper distributors. The British Library Association set up a committee which drew up some permanence specifications for paper. In general, however, the paper trade continued to sell its goods as "100% rag," "50% rag," or "sulphite" and induced the buyer to believe that the more he paid, the greater was the probable longevity of the paper.

When the laboratory men began to work on paper specifications, not only was the source of the fiber studied but its chemical and physical qualities were examined. The most important material comprising the fibers used in papermaking is the organic substance known as cellulose, the cell wall of the plant, and its chemical properties are essentially the same whether it is found in the cottonseed hair, cornstalks, or trees, whether it goes to the paper mill as a discarded shirt or a spruce log. In all papers cellulose is the basic ingredient, although there is a big difference in the structure of different fibers and this is an important characteristic in papermaking. Furthermore, associated with cellulose in the crude or unpurified fiber, there are often undesirable substances, called impurities, which are removed by chemical treatment as already indicated. These impurities vary in nature and in amount, depending on the source of the fiber. Ordinary pulp wood is composed of over 50% cellulosic material and "impurities" to the extent of about 30%. When newsprint paper is made by grinding logs into mechanical wood pulp, all the "impurities" or undesirable substances go into the paper. Raw cotton, on the other hand, represents a fiber containing about 90% cellulose and a minimum of "impurities."

Tests which are often used to determine the purity and quality of the fibers composing a paper are: acidity, sizing, alpha cellulose, and copper number. In general, there is agreement among paper technologists that the acidity and the rosin sizing should be kept low for a permanent paper. The alpha cellulose content of a paper refers to that portion of the cellulose which is not soluble in a solution of sodium hydroxide under certain defined conditions.[6] These are entirely empirical conditions however. The alkali-resistant or alpha cellulose content of the cellulose portion of a paper is presumably proportionate to the fiber purity, a high percentage alpha cellulose value being desirable for a permanent paper. The copper number is also indicative of fiber purity, the higher the number the greater the degree of damage to the fibers. Other tests which have been used in specifying book papers for permanent records are: ash, folding endurance, bursting strength, opacity, weight, and thickness. No single test can be considered at the present time as an adequate criterion of paper permanency. Even the lists of tests, mentioned above, yield a not too satisfactory picture of the probable life expectancy of a paper as far as purity of the sheet is concerned. Other tests which may become more reliable indices of paper permanence are now in the process of development.

Paper manufactured from the highest grade of cotton rags receives the minimum of treatment. The raw material itself is of a very high degree of purity and, carefully processed, yields from known experience a paper of very great permanence and durability. Such papers possess an alpha cellulose content well over 90% and a copper number considerably less than 1.0. Lower grade rags and chemical wood pulps require more severe treatment in their isolation or purification before being converted to paper. Ordinary processes of making chemical wood pulp do not yield a product with 90% alpha cellulose content. Purification processes are now available, however, whereby the alpha cellulose content of such pulps, referred to as "alpha pulps," approaches that of the better grades of cotton rags.[7]

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[6] Alpha cellulose can be separated from its bad relatives, beta and gamma cellulose, by giving the fibers a bath in caustic soda. Some of the cellulose of the fibers will be dissolved into a liquid. Some of the liquid can then be jellied--this is beta cellulose. Some of the liquid refuses to jell--this is gamma cellulose. But the pure, strong cellulose resists the action of the caustic soda. It is alpha cellulose, the white hope of paper chemistry.

When purified, chemical wood pulps have proven very satisfactory for certain papers and as a substitute for certain grades of rags. With our increasing knowledge of paper, its raw materials and manufacture, the future may provide a more permanent paper made from a greater variety of materials.

Proposed Classification and Specifications for Permanent Book Papers

(1) Classification of Book Papers Relative to Their Permanence Qualities[8]

A system of classification of printing and writing papers relative to their permanence qualities has been suggested by the United States Bureau of Standards.[9] Mr. B. W. Scribner, of the Bureau of Standards, proposed that the ingredients to be specified be a percentage of alpha cellulose, and he suggested, as an additional innovation, an accelerated aging test of "stability" specification. Underlying this test is the assumption that paper deterioration is a chemical action which can be accelerated by the influence of heat. Paper samples of known alpha cellulose content, chemical purity, and physical strength are subjected to oven heat for seventy-two hours at 100° C., and then tested for loss of chemical and physical qualities. The loss is expressed as a percentage. This classification is based upon the purity and strength of the finished paper. The values given are derived from the results of the extensive investigations of the Bureau during the past four years into the permanence of paper. In these investigations, tests similar to the ones described here have been made on a large number and variety of papers, and it is believed that papers fulfilling the requirements of the various groups will have the relative degrees of permanence indicated.[10]

In this system of classification, all papers are divided into four classes. The first class contains those papers which may be expected to have maximum longevity. A book paper fulfilling the requirements of this class would be particularly suitable for bound volumes of records having permanent value. The second class contains papers of high purity. Papers used for semipermanent records and in fine editions of rare and costly books should fulfill the requirements of this class. The third class is composed of papers which, while not having as high a degree of purity as those in the first two classes, have a fair degree of purity. Such papers could be used where moderate longevity is desired, such as in reference periodicals. Papers in the fourth class are those suitable for current use only.[11] Table XXXIV, on the following pages, illustrates in detail how such a system of classification might be applied to book papers.

(2) Specifications of the Joint Committee on Printing U. S. Government.[12]

Government specifications for permanent papers antedate all other similar specifications in this country by several years.

The paper must be made with every precaution to insure the maximum serviceability and permanency. Care must be taken to use the minimum quantities of bleach, rosin, size, and alum. The finished paper must not show the presence of any injurious residual chemicals which will interfere in any way with the permanency of color or the serviceability and durability of the paper.

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7. The Brown Company, pulp manufacturers of Berlin, New Hampshire, have developed some of these refining processes and have put their highly purified pulp on the market as "solka fiber." Paper chemists are not certain as to how far such highly purified wood pulps can displace rag fibers as an ingredient for permanent papers. The Brown Company sponsored a study of this problem at the Bureau of Standards.
8. Taken from John O. Burton, "Permanence Studies of Commercial Book Paper," Bureau of Standards Journal of Research, 7, 437-9 (1931).
9. B. W. Scribner, "Permanence Standards for Printing and Writing Papers," LII, 19, pp. 52-5 (May-August, 1930); also Paper Mill, LIII, p. 13, June 21, 1930.
10. The full text of the Scribner-Burton specifications is in the Appendix at the end of this Chapter.
11. It should be noted here that an additional "stability" specification is included for Class I papers: that alpha cellulose content should not decrease more than 1.5%, folding endurance more than 25%, and copper number should not increase more than .05%, after the paper is heated 72 hours at 100° C.
12. Issue of December 8, 1932, p. 15.

TABLE XXXIV

CLASSIFICATION OF BOOK PAPERS

Class I. Papers of Maximum Purity for Permanent Records

Stock: Free from unbleached or groundwood fibers
Alpha cellulose: Not less than 90%
Copper number: Not more than 1.5
Acidity: pH value not less than 4.5 and acid number less than 25
Rosin: Not more than 1.0%
Stability: When heated for 72 hours at 100° C. the alpha cellulose content shall decrease not more than 1.5%, the folding endurance shall decrease not more than 25%, and the copper number shall increase not more than 0.5
Weight, Strength and Opacity:

Weight: (25 x 40,500)--pounds	35	40	50	60	70
Weight: (25 x 38,500)--pounds	33.3	38.0	47.5	57.0	66.5
Folding endurance: Average each direction, not less than double folds	75	100	125	160	200
Bursting strength: Average not less than--points	20	25	30	35	40
Thickness: Average--inch	0.0035	0.0040	0.0050	0.0060	0.0060
Tensile breaking strength					
Average not less than kg. per 15 mm. width					
Machine direction	4.0	5.0	6.0	7.0	8.0
Across direction	2.0	2.5	3.0	3.5	4.0
Opacity: Contrast ratio not less than--%	84	86	89	90	90

Color, finish, formation and printing quality
Shall be in accordance with sample

Class II. Papers of High Purity for Semi-Permanent Records

Stock: Free from unbleached or groundwood fibers
Alpha cellulose: Not less than 80%
Copper number: Not more than 2.0
Acidity: pH value not less than 4.5 and acid number less than 25
Rosin: Not more than 1.5%
Weight, Strength and Opacity:

Weight: (25 x 40,500)--pounds	35	40	50	60	70
Weight: (25 x 38,500)--pounds	33.3	38.0	47.5	57.0	66.5
Folding endurance: Average each direction, not less than double folds	30	40	60	80	100
Bursting strength: Average not less than--points	12	14	18	22	26
Thickness: Average--inch	0.0030	0.0035	0.0045	0.0050	0.0050
Tensile breaking strength:					
Average not less than kg. per 15 mm. width					
Machine direction	3.0	3.0	4.0	5.0	6.0
Across direction	1.5	1.5	2.0	2.5	3.0
Opacity: Contrast ratio not less than--%	84	86	89	90	90

Color, finish, formation and printing quality:
Shall be in accordance with sample

Testing Methods: The testing methods shall be those approved by the Technical Association of the Pulp and Paper Industry. The physical specifications are for a relative humidity of 65% and a temperature of 70° F., which are the testing conditions approved by this Association.

Class III. Papers of Fair Purity for Records Requiring Moderate Longevity

Stock: Free from unbleached or groundwood fibers
Alpha cellulose: Not less than 70%
Copper number: Not more than 3.5
Acidity: pH value not less than 4.5 and acid number less than 25
Rosin: Not more than 2.0%
Weight, Strength and Opacity:

Weight: (25 x 40,500)--pounds	35	40	50	60	70
Weight: (25 x 38,500)--pounds	33.3	38.0	47.5	57.0	66.5
Folding endurance: Average each direction, not less than double folds	15	20	30	40	50
Bursting strength: Average not less than--points	11	12	15	19	22
Thickness: Average--inch	0.0025	0.0030	0.0033	0.0040	0.0050
Tensile breaking strength:					
Average not less than kg. per 15 mm. width					
Machine direction	3.0	3.0	3.5	3.5	4.0
Across direction	1.5	1.5	2.0	2.0	2.5
Opacity: Contrast ratio not less than --%	84	86	89	90	90

Color, finish, formation and printing quality:
Shall be in accordance with sample

Class IV. Papers for Temporary Use

Stock, Acidity and Rosin: No requirements
Weight, Strength and Opacity:

Weight: (25 x 40,500)--pounds	35	40	50	60	70
Weight: (25 x 38,500)--pounds	33.3	38.0	47.5	57.0	66.5
Bursting strength:					
Average not less than--points	9	10	12	14	15
Thickness: Average--inch	0.0025	0.0030	0.0033	0.0040	0.0050
Tensile breaking strength:					
Average not less than kg. per 15 mm. width--					
Machine direction	3.0	3.0	3.5	3.5	4.0
Across direction	1.5	1.5	2.0	2.0	2.0
Opacity: Contrast ratio not less than --%	84	86	89	90	90

Color, finish, formation and printing quality:
Shall be in accordance with sample

Testing Methods: The testing methods shall be those approved by the Technical Association of the Pulp and Paper Industry. The physical specifications are for a relative humidity of 65% and a temperature of 70° F., which are the testing conditions approved by this Association.

Stock:	100% new rags, white, cream or unbleached			
Ash:	Not to exceed 15%			
Acidity:	pH value not less than 5.0			
Sizing:	Rosin not to exceed 1.0%			
Weight:	25 x 38, 10,000	Lbs.	90	140
Folding Endurance:	Average, each direction not less than ____________ double folds		75	150
Bursting strength:	Average not less than __________	points	25	40
Thickness:	Average	inch	0.0040	0.0055
Opacity:	Not less than ________________	%	86	90

Color, Finish, Formation, and Cleanliness: Deliveries must conform to the standard sample.

Note: The physical specifications of the Government Printing Office are based on tests carried out at a relative humidity of 50% and a temperature of 70° F.

The Paper Trade and the Proposed Specifications

The interest of the paper trade in specifications is recent and welcome. Technical knowledge is far ahead of the market conditions. Some of the conclusions of paper technologists are in satisfactory agreement and can be used safely as a guide by publishers in search of permanent paper. However, on entering the market to buy paper, the publisher discovers that the distributing trade is not accustomed to the use of even the minimum specifications upon which there is agreement.

The Rag Paper Division of the Writing Paper Manufacturers' Association has suggested tentatively some specifications, which are set forth in a comparative table at the end of this chapter; but for a final judgment on permanence specifications, it awaits the conclusion of the experimental work in progress.

A test made at the Bureau of Standards confirms the fact that a purchaser who merely specifies a percentage of rag content in a book paper has no assurance that he is paying for permanence quality. Thus is the importance of careful specifications brought out.

A list of the book papers investigated by John Burton[13] is herewith tabulated (Table XXXV, on the following page) with the proposed permanence classification indicated in each case. This is based on chemical and physical tests on the papers. For this proposed classification, see an earlier portion of this chapter.[14] According to this classification system only one of the twenty-eight papers studied could qualify as a permanent and durable paper, but several were only slightly deficient. The importance of careful processing of fibers was emphatically brought out as a result of this investigation. A fiber of initial high quality may have its purity seriously lowered by improper processing, and fibers of much lower original purity may be purified to a high degree by proper treatment.

These data serve to bring out the importance of careful specifications in the matter of permanent and durable book papers, no single test or specifications being adequate.

Conclusions for the Paper Buyer

It is easy to understand why ordinary market book papers, whether of rag,

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[13] John O. Burton, "Permanence Studies of Current Commercial Book Papers," Bureau of Standards Journal of Research, VII (1931), 429-39.

[14] These tests were made in 1930; the manufacturers since that time have probably improved their products. But some advertising is still misleading. The writer has seen advertising matter which proposed the following absurd specifications: 50 to 100 years, 100% rag; 35 to 50 years, 75% rag; 15 to 35 years, 50% rag; 5 to 15 years, 25% rag; 3 to 5 years, sulphite.

TABLE XXXV

BOOK PAPERS AND PROPOSED PERMANENCE CLASSIFICATIONS

Sample No.	Description of Materials Used in Manufacture as Furnished by Manufacturers	% Rag	% Chemical Wood Pulp	Permanence Classification
1	New cotton rags, 85%, and new linen rags, 15% rosin sized	100	-	III
2	Chemical wood pulp containing some highly purified wood pulp; rosin sized, clay filled	-	100	III
3	Bleached cotton fiber, 75%, and bleached sulphite pulp, 25%; sized with 2% rosin and alum	75	25	III
4	Bleached sulphite pulp, 50%, and unbleached sulphite pulp, 50%; rosin sized	-	100	IV
5	Same as No. 2, except highly purified wood pulp was replaced with an equal amount of cotton linters	?	?	III
6	Rag fiber, 50%, and sulphite pulp, 50%; rosin sized, clay filled	50	50	III
7	Rag fiber, 85%, and sulphite pulp 15%; rosin sized, clay filled	85	15	III
8	White, uncooked rags, 100%, rosin sized	100	-	III
9	Rag fiber, "twos and blues" grade, 55%, and chemical wood pulp, 45%; rosin sized, clay filled	55	45	IV
10	Rag fiber, "twos and blues" grade, 50%, and chemical wood fiber, 50%; rosin sized, clay filled	50	50	IV
11	Bleached chemical wood pulp, 100%, rosin sized, clay filled	-	100	IV
12	Rag fiber, "twos and blues" grade, 100%; rosin sized, clay filled	100	-	IV
13	Rag fiber, "No. 1 White" grade, 100%; rosin sized, clay filled	100	-	IV
14	Rag fiber, "No. 2 White" grade, 100%; rosin sized	100	-	IV
15	Rag fiber, "No. 2 White" grade, 100%; rosin sized	100	-	III
17	White linen and cotton rags, 100%; rosin sized	100	-	III
22	Rag fiber, 50%, and bleached chemical wood pulp, 50%; rosin sized, clay filled	50	50	IV
24	Bleached chemical wood pulp, 100%; rosin sized, clay filled	-	100	IV
25	Rag fiber, 100% rosin sized; used for permanent editions of newspapers and periodicals	100	-	II
28	Rag fiber, 50%, and bleached chemical wood pulp, 50%; rosin sized, clay filled	50	50	III
31	Bleached chemical wood pulp, 100%; double-coated book paper	-	100	III
32	Rag fiber, 50%, and bleached chemical wood pulp, 50%; double-coated paper	50	50	II
37	New rags, 100%; rosin sized	100	-	I
38	"No. 1 White" grade of rags, 37.5%, "thirds and blues" grade of rags, 37.5%, and sulphite wood pulp, 25%, rosin sized, clay filled	75	25	II
40	Rag fiber, 50%, bleached chemical wood pulp, 50%; rosin sized, clay filled	50	50	III
41	Rag fiber, 50%, and bleached chemical wood pulp, 50%; double-coated book paper	50	50	III
45	New white and cream rags, 100%; rosin sized. This paper was manufactured especially with a view to permanence	100	-	II
46	Same as paper No. 45, but from a different delivery	100	-	II

chemical wood pulp, or mixture, should not be permanent papers; and emphasis has been on beauty and printability rather than on permanence and durability. Paper technologists have the formulae for papers which would satisfy the demand for permanence but such a demand has not been large enough to control market practices. The lack of agreement over specifications has made it difficult for the buyers who want permanence to exert their full weight in the market, and the small buyer can have little influence even if he knows what he wants unless he happens to want a stock commodity.

A number of specifications are included in an appended chart which gives, in addition, the properties and approximate prices of certain all-rag or purified chemical wood pulp papers, actually or potentially available.

How are these specifications to be interpreted? The paper technologists quickly draw the layman beyond his depth in the discussion, but a few facts stand out as agreed or uncontested, and upon these the publisher may safely base his policy.

(1) Fiber Content of Highest Class Papers

It is always insufficient to specify merely a source of the fibers, as, for instance, "rag" or "50% rag." Now only should the quality of the fiber be specified but specifications covering the manufactured paper should be carefully drawn. These should include ash content, acidity, rosin sizing, alpha cellulose, copper number, folding endurance, bursting strength, and perhaps other tests depending on the use requirements of the sheet. No one or two tests alone, any more than the source of the fiber, can entirely define the permanence of a paper. For instance, some of the new fillers now being used in book papers will give a high false copper number without any other indication of impermanence. Others believe that a low alpha cellulose of rags which have been properly purified is not an index of impermanence. It is natural that the more information we have concerning the properties of a paper, the more can we judge of its general quality and usability for the purposes we have in mind.

Although it is admitted that there is no general agreement on the specifications necessary for a permanent paper made from fibers other than the highest grade of rags, the dealers and even the buying public in general have been slow to realize the need for and the significance of a permanent book paper. When the buyers specify these superior properties in a paper, the manufacturers will quote prices consistent with the specifications and the desired product will be delivered. It lies with the buying public to assist the manufacturers to keep pace with the findings of the paper technologists.

(2) Fiber Content of Second-Class Papers

Price becomes a leading consideration among the less permanent papers, and specifications do not have to be as rigid as with the first-class papers. Thus, in the Burton classification for book papers of high purity for semi-permanent records, the chemical and physical constants are extended considerably beyond those for book papers of maximum purity for permanent records. The buyer should test and carefully check to specifications all papers before use in order to be sure he is getting his full money value. Again, no single test should be used as a criterion of the permanence quality of the paper under consideration.

(3) Ground or Mechanical Wood Pulp

No groundwood or mechanical wood pulp should be present in any paper designed for anything more than temporary use.

(4) Acidity

It is undisputed that high acidity causes rapid deterioration of paper. Acidity is measured in two ways: the acid number is determined by volumetric analysis and indicates the amount of acid present, while the pH value is a measure of the hydrogen-ion concentration or strength of the acid. A paper testing pH 4.5, for instance, is about 30 times more acid than one testing pH 6 and is more likely to become degraded on this account.

(5) Sizing Material

The presence of large amounts of rosin as a sizing material in paper is likely to bring about a discoloration or yellowing in papers on aging. There is general agreement that the rosin content of permanent papers should be kept low, probably below 1%.

(6) Fillers or Loading Materials

There is not complete agreement as to the significance of mineral fillers for permanent and durable papers. Too much material will probably reduce the durability of the sheet, but a small amount of the proper filler does no harm in the opinion of many paper technologists.

The Influence of Price

The paper buyer can be sure that any of these permanence specifications are better than none; they emphasize different elements of the paper, but they all agree in guiding the purchaser away from papers which have been manufactured (as many book papers are manufactured) without taking into account any permanence requirements whatsoever.

The publisher who is using small quantities of paper stands two steps removed from the manufacturers. The trade is organized to distribute paper from manufacturer to jobber or dealer and from there to printer. In some cases the manufacturing process is divided, one firm making the pulp and another the paper. Since the qualities which give a paper its permanence are due in large measure to the manufacture and processing of the pulp, it is especially desirable that the buyer should make a special effort to secure paper conforming to permanence specifications.

If he enters the market with some permanence specifications he will probably find his printer, and the printer's jobber, unequipped with any tested papers. He may have to work his way back to the manufacturer. He will find that paper is sold normally in 500-pound cases, but that manufacturers will often make a special run of paper for an order as small as 1 ton (4 cases). The manufacturing and selling units are case, ton and carload (15-18 tons). The trade is familiar with the practice by which price drops as the size of the order increases to the carload; these price variations are of use in interpreting comparative pricing of paper, but of the greatest importance because they constitute an index of the size of order which will have sufficient importance to induce a manufacturer to conform to permanence specifications.

The Joint Committee on Materials for Research has found some firms willing to have their paper quoted in terms of a price index. If "normal," i.e., low-cost book paper is $.08 a pound, then these papers would be sold at the prices listed in the table. The Rag Paper Division of the Writing Paper Manufacturers' Association advises that if the base price is $.08, the price of a permanent paper meeting their specifications should be $.32. The prices named in connection with Government Printing Office specifications are those actually bid in 1932. It must be observed that this relationship in prices prevails: the "offset book" paper (not for permanent use) was bought at less than $.04, and the "permanent record book" paper at over $.16. It is evident, therefore, that large quantity orders and competitive bidding can reduce prices greatly, but the ratio between prices of papers of different qualities is not radically changed.

Under normal trade conditions the trade mark-ups and discounts should permit price variations in the following scale: (A paper selling at $.05 a pound, i.e., $10.00 a case in 2 1/2 ton lots).

Price from Manufacturer to Distributor
Price per Case in Lots of:

1 case	1 ton (4 cases)	2½ tons	5 tons	18 tons (carloads)
$11.00	$10.50	$10.00	$9.70	$9.50

The distributor's mark-up would range from $1.60 in the one-case lots to an extreme low of $.50 to $.95 in carload lots. The printer's mark-up should be anything from 10% to 25% of what he pays the dealer. These mark-ups do not constitute an excessive charge for the distributing service offered, nor do they greatly increase publishing cost.

How does paper cost figure into book cost? Paper is sold by the pound; a standard size of sheet is 25" x 38"; the weight of the paper is usually given as that of 500 sheets, 25" x 38". Since a sheet of this paper will print 24 pages, 8" x 9 1/2", a ream will supply paper for

38 copies. Paper weighing 45 pounds to the ream--a good stout book paper weight, as the paper samples indicate--will make up a 300-page book weighing a little over one pound. The difference between the highest and the lowest paper prices would not come to more than $.30 a volume, or less than 10% of the cost of an edition of 300. If the edition is small, the use of the most expensive paper need not greatly increase the price of the book, but may greatly increase its utility.

But most book manufacturing--practically all commercial book manufacturing --calls for larger editions, in which the composition and press charge is distributed over more copies, and the paper cost therefore proportionately higher. Moreover, the economics of the publishing business require that each book shall be printed in an edition larger than that for which there is immediate and certain sale. The chance of selling some of the overprint affords the prospect of profit. But the storage of unsold volumes increases the paper cost which must be borne by the volumes actually sold. If in an edition of 1000 books, weighing one pound each, the cost of paper is increased $.07 a pound (from $.07 to $.14) the increased cost levied upon the purchaser need not be more than $.07 a volume if the whole edition is sold; but if only 250 copies are sold, the ratable portion of the added paper cost which each must bear rises to $.28. It is the storage of valuable paper in unsold books that makes it so costly to use high-priced paper in commercial publishing. And therefore, two policies open out before those who would improve the lasting quality of books.

The first is the policy followed by the New York Times: publication in two editions; one a small edition, for relatively certain sale, printed on expensive rag paper of high durability and permanence; the other an edition for temporary consumption. But the publishers assert that in commercial publishing such a policy would introduce many new costs, not only on the press, but in storing and filling orders. The American Library Association favors the application of this policy to government documents.[15]

The second policy is that which will be practicable as rag, purified chemical wood pulp or other papers at moderate prices prove to have satisfactory lasting qualities. The permanence level of all book papers can be raised, without greatly increasing prices. A basic economic argument helps at this point. The carefully manufactured rag papers with alpha cellulose content up to 97% can be manufactured to be more durable than a paper that merely passes the proposed Burton Class I tests. But it cannot be widely used in the publishing industry because of cost; its usefulness will lie in the small editions which do not threaten to leave their makers with a great bulk of expensive paper unsold on the shelves. The improvement of permanence qualities in the normal product of the publishing trade must depend upon the development of less expensive papers. The buyer must be induced to demand what the technicians are able to make, a rag or purified chemical wood pulp paper manufactured for permanence, and sold at a moderate price.

Preservation of Old Newsprint Paper

Whatever improvement in standards of manufacture and choice of paper may be anticipated, it cannot affect the fifty years' legacy of inferior paper that has already been used and that now stands on our library shelves in imminent peril of dissolution. Newsprint paper is especially vulnerable. Can it be saved?

The Bureau of Standards reached a certain point in devising a method of pressing sheets of cellulose acetate into the newsprint fiber in such a way that the air was excluded and tremendous folding endurance developed. This process required no adhesives. The New York Public Library protects some of its newspaper files by covering both sides of the sheets with Japanese tissue paper, then smoothing them by running them through a heated mangle. This process has been used by the New York Public Library since 1916. Legibility is decreased somewhat, but the library feels that its experience indicates that this disadvantage is offset by the increased strength and lengthened span of life of the paper. The cost of this process is

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15. The University of California Press applies it to scientific publications, printing 25 copies on a rag stock conforming to U. S. Government Printing Office specifications for highest permanence (see chart).

approximately \$.08 a sheet, or \$.04 a page. A sample of the New York Public Library product is bound herewith. Dr. Joseph Broadman of New York City has developed a similar plan for pasting a protective transparent layer over each newsprint surface.

It is possible that the preservation of the newspaper records will not be feasible by way of the preservation of the paper, and it may be that the files printed on the most impermanent stock can be preserved only by film-copying them and letting the originals disappear. This problem will be discussed in Chapter XI in connection with the cost levels of microcopying on film. The question has already received some attention in Chapter III as a special case of reprinting material by photo-offset.

APPENDIX

The following material was not approved by the Technical Association of the Pulp and Paper Industry, but is printed herewith, not as a part of the discussion carried above, but as supplementary information offered subject to the layman's qualms as to its accuracy.

The Scribner-Burton specifications are as follows:

EXCERPT FROM PAPER BY B. W. SCRIBNER, BUREAU OF STANDARDS, ON PERMANENCE STANDARDS FOR PAPER

In consideration of both usage of papers and the grades of papers available, it is suggested that they might be classified in four main groups according to their degree of cellulose and non-cellulose purity, as related to their service requirements. According to such mode of classification, the present domestic printing and writing papers may be grouped as follows:

Grade I. Permanent papers, having a maximum degree of purity; free from unbleached fibers, and highly lignified fibers such as groundwood. Indicative chemical properties: alpha cellulose, 90%; copper number, 1.5; rosin, 1%; acidity, 5 pH; changes on heating 72 hours at 100° C.--decrease in content of alpha-cellulose should be not more than 1.5%, decrease in folding endurance not more than 25%, increase in copper number not more than 0.5.

Grade II. Papers quite highly purified that may be expected to have a minimum life of 100 years; free from unbleached fibers, and highly lignified fibers such as groundwood. Indicative chemical properties: alpha cellulose, 80%; copper number, 2.5; rosin, 1.5%; acidity, 5 pH.

Grade III. Papers having a fair degree of purity that may be expected to have a minimum life of 50 years; free from unbleached fibers and highly lignified fibers such as groundwood. Indicative chemical properties: alpha cellulose, 70%; copper number, 5; rosin, 2%; acidity, 5 pH.

Grade IV. Papers having a low degree of purity containing considerable organic impurities, suitable for current use only. This grade includes papers containing unbleached fibers, and highly lignified fibers such as groundwood.

All figures for chemical components in these grade descriptions are upper limits, except for alpha cellulose contents which are lower limits. Alpha cellulose content and copper number are based on total cellulose content.

As stated in these grade descriptions, the purity limits are given merely as indicative and are not suggested as specification requirements, for the fixing of specification details must necessarily be done by the consumers and manufacturers directly concerned. In each of these grades, the establishment of two or more strength requirements for each weight of paper is necessary. Also, as less strength is required in book papers than in writing papers, different strength ranges are necessary for these two classes of paper. The strength requirements, of course,

he case had been based mainly
evidence indicating, according
he prosecution, that the com-
y issued misleading statements
promote sales of mortgage cer-
ates.

the dénouement of the trial
ard Tompkins, special attorney
the Department of Justice, and
ter Brower, a special assistant
Attorney General Cummings,
a clear mandate to go ahead
the prosecution of the officials
ive other mortgage companies.
first of these, the trial of six
cers of the National Title and
rantee Company, is set for
t. 8. They had not decided when
would ask for a retrial of Mr.
dil.

White Plains Monroe Cahn, of
nsel for the convicted men, said
eals would be taken in the near
re. The grounds for this action
ld include his contention, he
, that the verdict against Ste-

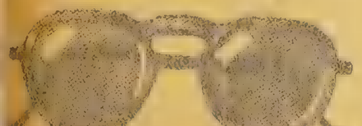
GIMBELS

33rd & B'way PE 6-5100

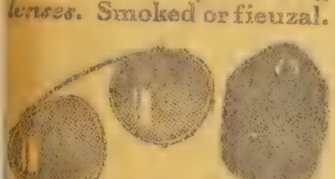
ptically Constructed

Sun Glasses

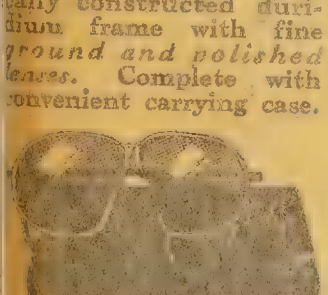
98c ea.



1. Optical quality zyl-hinge jointed frame, with *ground and polished lenses.* Smoked or fieuzal.



2. Slip over your own glasses. All shapes, optically constructed duridium frame with fine *ground and polished lenses.* Complete with onvenient carrying case.



3. Sport goggle with famous patented azurine quille lenses. Prevents re—but lets in light. olors remain unchanged. omplete with carrying ase and antiseptic eaner.

MAIL AND PHONE ORDERS FILLED

Please Order By Number

ameras—Sixth Floor

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500 TISSUES

Kleenex

500's

31c a box

3 boxes 92c

These fine, soft, throw-away tissues are perfect for removing cleansing cream, cold cream, lipstick. You'll find they're perfect for removing excess nail polish and nail creams.

A Rare Chance!

REG. $1.00 SIZE

HOUBIGANT

Talcum Powder

59c

2 for $1.17

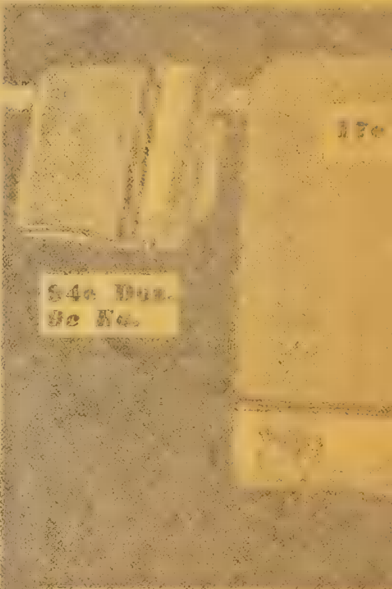
To dispose of their stock of discontinued bottles, Houbigant's is offering their exquisite Quelques Fleurs and Le Parfum Ideal Talcum at the very low price of 59c. Talcum acts as a delightful antidote for heat and sunburn. Get several bottles.

MAIL AND PHONE ORDERS FILLED

No C. O. D.'s under $1

GIMBELS—*Drugs & Toiletries—Street Floor*

NARRA
Made to sell for



Tomo

"Run-o

HAND

16x28 in

BATH

22x44 in

*WASH

12x12 inch

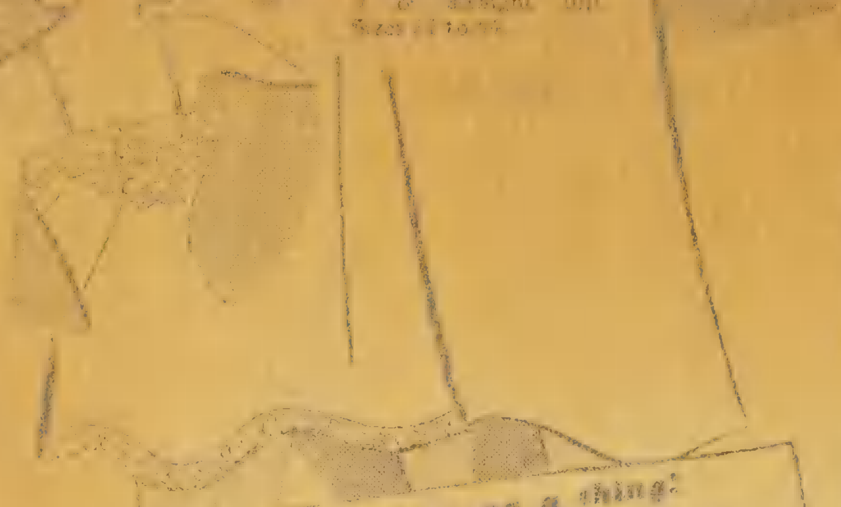
BAT

22x32 inc

Did you find yourself
happen to you again
buy thick, fluffy, fa
Nothing wrong with
Solid color reversibl
* *In 8 patterns.*

MAIL AND PHO

Would You Like a G
Purchases may be made
the balance September
Accounts, Gimbels, 10th



STANDBY — straight cut, 4-gore pure dye silk crepe slip for women who don't like the bias cut. Hemstitched front, 4-inch hem. Sizes 34 to 44.

COCKTAILS — beautiful pure dye satin slip with Val lace EMBROIDERED on, top and bottom. Sizes [illegible] to [illegible].

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wear. Panel fro
neck. Sizes 32 t

We haven't slipped up on a thing!

Lovely heavy quality satin and crepe, "no weighting" Shadow proof panels for your sheerest dresses; double tops, front and back, so that you need wear nothing underneath. Adjustable straps, seams double stitched.

Dainty val lace trimming or elaborate alencon-type lace TOP AND BOTTOM.

Accurate in cut . . . if you WEAR size 36 . . . BUY a 36 . . . it will fit perfectly

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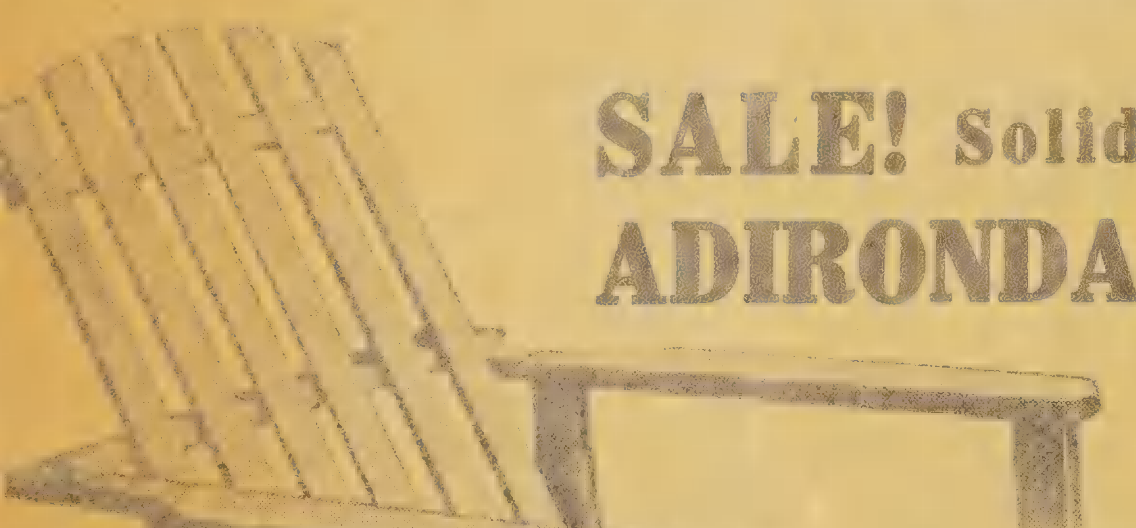
Style	*Quantity*	*Color*	*Size*
BUSINESS			
WEEKEND			
STANDBY			
COCKTAILS			
CRUISE			

SALE! Solid Maple and Oa
ADIRONDACK CHAIR



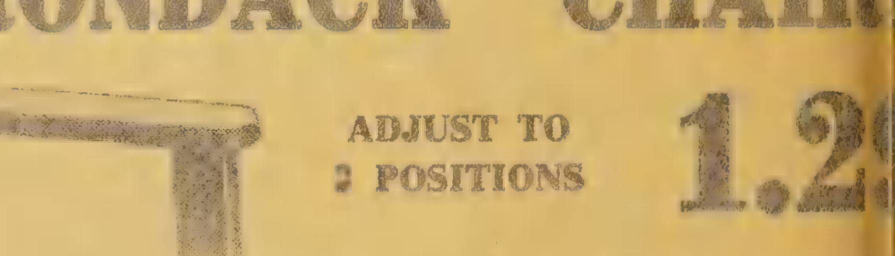
ADJUST TO
3 POSITIONS

1.2

Arms screwed on with [illegible] coun sunk screws. Sides fasten w bolts. Smoothly finished. painted. In the two weeks w had them we've sold thousa Get yours Monday!

MAIL AND PHONE ORDERS FIL

Unpainted Furniture—Sixth Floor


Sit Up!
Recline!
Relax!

WATER REPELLENT PAD
Red, Green or Blue **1.19**
Three Days Delivery

At Bloomingdale's you are assured of the same low prices whether you pay cash on each purchase, or use a charge account and pay cash a month—either way Bloomingdale's price policy protects you.

must be fixed with consideration of the kind and extent of mechanical stresses to which the paper will be subjected in its use. The strength gradations of the government papers should be of particular assistance in this respect, although as they refer to a testing condition of 50% relative humidity, they should be modified for commercial use to accord with the standard commercial testing condition of 65% relative humidity.

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These specifications led the Joint Committee to interests itself in the possibility of utilizing a purified wood-pulp fiber in lieu of rag fiber where permanence is desired. In an effort to make a practical demonstration of the possible use of a wood-pulp paper manufactured for permanence, the Joint Committee received the coöperation of Dill and Collins, Paper Manufacturers of Philadelphia, and Scribners, publishers of the Dictionary of American Biography. Dill and Collins manufactured a sample lot of highly purified wood-pulp paper. This paper was used for one-third of the pages of 25 copies of Volume XIII of the Dictionary. An all-rag paper of high alpha cellulose content was purchased from the Worthy Paper Company for another third of the pages. The remaining third were printed on the paper supplied by the American Writing Company.

The alpha cellulose and copper number and accelerated aging test of these three papers are shown in the table below.

These 25 copies have been placed on the shelves of the following libraries, where they will encounter different kinds of air and use. The reader is advised to examine them.

1. Dartmouth College, Hanover, New Hampshire
2. Boston Public Library, Boston, Massachusetts
3. Columbia University, New York City
4. New York Public Library, New York City
5. St. Lawrence University, Canton, New York
6. Library of Congress, Washington, D. C.
7. University of North Carolina, Chapel Hill, North Carolina
8. Public Library, Jacksonville, Florida
9. Howard Memorial Library, New Orleans, Louisiana
10. St. Louis Public Library, St. Louis, Missouri
11. Cincinnati Public Library, Cincinnati, Ohio
12. Cleveland Public Library, Cleveland, Ohio
13. Carnegie Library, Pittsburgh, Pennsylvania
14. John Crerar Library, Chicago, Illinois
15. Iowa State College Library, Ames, Iowa
16. Butte Public Library, Butte, Montana

SPECIFICATIONS FOR A WOOD-PULP FIBER PAPER

Concern	Alpha Cellulose	Copper Number	Loss of Folding Endurance under Accelerated Aging Test	Alpha Content After Aging
Dill and Collins purified wood pulp	90.7%	______	______%	87.25%
Worthy Paper Co. all-rag stock	95.41	.45	______%	94.2
Dictionary of American Biography	83.11	2.307	6%	
American Writing Co. all-rag stock	95.00			91.8

17. Colorado College Library, Colorado Springs, Colorado
18. University of Arizona Library, Tucson, Arizona
19. University of Southern California Library, Los Angeles
20. University of California Library, Berkeley, California
21. Seattle Public Library, Seattle, Washington
22. Toronto Public Library, Toronto, Ontario, Canada
23. McGill University Library, Montreal, Canada
24. Dalhousie University Library, Halifax, Nova Scotia

To the publisher all this complexity is reduced to two simple questions: what price shall he pay for book paper, and what weight shall he give to the rag-content specification as against other specifications, such as those stated in terms of alpha cellulose content?

Let it be supposed then that the evidence is clear and undisputed that high price alone, and rag-content specifications alone, offer no guarantee of permanence, and even though the technician soon draws the layman beyond his depth in the discussion of specifications, a few facts stand out as agreed or uncontested.

1. A paper meeting the Scribner-Burton specifications for maximum permanence, with a life probability greater than that of most of the all-rag book papers on the market, can be made without rags, from purified wood fibers.

2. A paper capable of surviving more severe tests than those proposed by Scribner, with a life probability greater than that of the best purified wood-pulp paper, can be made of new muslin cuttings.

3. The adoption and enforcement of specifications calling for either of the two papers described above would constitute an immense improvement over current practices.

The difference in permanence between paper meeting Scribner specifications and paper surpassing those specifications is an unknown quantity; a definite estimate of the price difference can be made: if permanent purified wood-pulp papers cost $.10 to $.15 a pound, then the special permanent rag papers should cost from $.16 to $.35 a pound.

Correspondence with a number of paper manufacturers has yielded the information tabulated as to papers now available on the market. The results of the tests are as given by the manufacturers themselves; they have not been checked.

Because other paper manufacturers may wish to offer papers meeting these specifications, the writer has asked the Rag Paper Manufacturers' Association, Springfield, Massachusetts, and the American Pulp and Paper Association, New York City, to receive the names of manufacturers who may wish to offer products conforming to these specifications, and transmit them to prospective paper purchasers upon request.

The following firms are among those which will test papers to cover all the particulars of the specifications tabulated:

New York Testing Laboratories
80th Street and East Avenue, New York City

Arthur D. Little
Charles River Road, Cambridge, Massachusetts

Skinner and Sherman, Inc.
276 Sherman Street, Boston, Massachusetts

United States Testing Company
1415 Park Avenue, Hoboken, New Jersey

Bond Papers and Onionskin

Another field in which permanence is of great importance is that of bond papers, used for typescript correspondence and records of the archival type, and also in connection with the various near-print methods of reproducing text, such as mimeograph and hectograph. The general business practice of the country calls for a more permanent stock of paper for letters than for books, and a less permanent stock for carbon copies than for books. The average business letter sheet will last longer than the average book page; the average carbon copy will fall to pieces sooner.

As the problems of archive administration in business become better understood, it will no doubt become apparent that the carbon copies of certain classes of correspondence require more permanence qualities than the originals themselves, since they constitute the firm's records of its own commitments. The greater part of business correspondence is systematically destroyed after a period of a few years, but for those classes of business correspondence that are intended for permanent preservation, it is appropriate to insist upon paper specifications comparable to those used for permanent record books. Onionskin papers of rag content are available, and the Eaton Paper Company has developed a line of purified wood-pulp onionskin paper. Some of their literature credits this line with 93% alpha cellulose. Test data supplied by the Brightwater Paper Company on the same or a similar line shows alpha cellulose content of 88.25, copper number 1.68, and loss of folding endurance in accelerated aging, 37%. The writer has not explored the bond paper field except in a haphazard way, but believes that in the main the technological considerations governing permanence are the same for bond as for book papers, and that the argument for using chemical and performance specifications is as good in the one case as in the other.

Beauty and Legibility in Papers

The analysis of the paper situation from the standpoint of permanence has not taken into account the paper quality upon which the buyers of paper are most insistent, namely, beauty. The importance of an attractive paper in scholarly publishing is not alone its artistic contribution to the quality of a finished book, but also its relation to legibility. It has been demonstrated repeatedly that the legibility or attractiveness of a printed text is the product of many variables, such as size of type, format of page, and use of print face as against typescript letters. It is clear that paper quality also enters into legibility as an important variable. It seems quite probable that the product of the hectograph, with its light purple ink, could be made more legible and attractive if run on a yellow-ivory paper. A reader choosing between typescript and print face on a book page would have his choice materially affected if the print face should be offered on an unattractive paper, the typescript on a beautiful one. And here again a fundamental rule of small edition publishing must be respected: that because the paper cost is so small a part of the total cost, an economical place to seek for quality in the product is by using the highest class of paper.

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TABLE XXXVa

CHART OF PAPER SPECIFICATIONS

		Paper Specifications Proposed for Permanence							Papers on Market are Available if Demanded													
		Class I			Class I and III				Rag Papers								Mixed, or Wood-Pulp Papers					
		British Library Association Class I "Highest quality permanent record"	U. S. Rag Paper Mfg. Association specifications for highest permanence	U. S. Bureau of Standards "Maximum purity for permanent record"	British Library Association Class II Relative permanence and competitive price	U. S. Rag Paper Mfg. Association Class II	U. S. Bureau of Standards. Class II High purity; semi-permanent records	U. S. Bureau of Standards. Class III Fair purity; moderate longevity	Strathmore Paper Co. Permanent Book (made) of new rags)	U. S. Government Printing Office Permanent Record Book	Harper Inc. 100 B. R. Rag Newsprint	Harper Inc. 100 B. R. Rag Book	Hurlbert Paper Company	Worthy Paper Company (Worthy Hadrian)	Worthy Paper Company Plain Laid Book	Worthy Paper Company Low Price All-Rag Book	U. S. Government Printing Office 50% Rag Book	U. S. Government Printing Office Offset Book	Brown Company Paper A	Brown Company Paper B	Brown Company Paper C	Warren Paper Company Paper A
Fiber	Stock: rag or wood content, or alpha cellulose	100% new rags	100% new rags	90% alpha cell.	100% chem. wood	100% chem. wood	80% alpha cell.	70% alpha cell.	97% alpha cell.	100% new rags	100% mixed rag	100% mixed rag	100% new rags	100% new rags	100% old rag	100% old rag	50% new rags 50% chem. wood	100% chem. wood	4/5 95% 1/5 80% alpha cell.	95% alpha cellulose	95% alpha cellulose	93% alpha cellulose
Quality and Aging Test	Decreased alpha cell. after heating 72 hrs. 100° C.			1.5					0.5													
	Copper number not over		0.5	1.5		1.5	2.0	3.5	0.25		.47	1.35		1.12	0.72	0.58			1.5-1.8	1-1.2	1-1.2	
	Increased copper number after heating 72 hrs. 100° C.			0.5					0.1					0.45	0.39	0.53						
Acidity	Acidity: hydrogen-ion concentration not below	5½-6 pH	5 pH	4½ pH		5 pH	4.5 pH	4.5 pH	5.2 pH	5 pH			6.2 pH	4.62 pH	4.30 pH	4.40 pH	4.7 pH	4.5 pH	5-6 pH	5.5-5.8 pH	5.5-5.8 pH	
	Acid number less than			.25			.25	.25			.21	.30										
Size and Loading	Percentage of rosin sizing not over		1.2	1.0	2	1	1.5	2	0.5	1			.5	1.25	1.55	1.34	1.5		1.25	.5		
	Percentage of mineral loading not over				5				5				12									
	Percentage of ash not over								3.5	15				.600	.601	.994	15	15	.2	.15	.15	
Physical Quality and Aging Test	Weight, (500 sheets, 25 x 38 inches) lbs.			47.5			47.5	47.5	60	45		60		50	80	60	45	60				
	Folding endurance, average, double folds			125			60	30	100	75	64	16		1371	22	16		10				
	Decreased folding endurance after heating 72 hrs.			25%					10%					37%	37%	42%						
Price	Approximate or basic price.								35¢ ?	17¢?	24½¢	23½¢		35¢	22¢	16¢	6½¢	3½¢	10¢		14/15¢	
Availability									In stock	1932 bid	In stock	In stock	Not in stock	In stock	In stock	In stock	1932 bid	1932 bid	Not in stock, but can be manufactured			Can be mfg. in ton lots

CHAPTER IX

BINDING, VERTICAL FILING, AND FILM STORAGE

The use of typescript and near-print in the production of small editions of documents of internal circulation in scholarship need not necessarily give rise to new library problems. If most of these documents turn out to be books of size appropriate for binding, the librarian need not be subjected to any change in routine corresponding to the change in the methods of distributing written matter among scholars. But if it should develop that a considerable proportion of these documents of internal circulation are of less than book size, the librarian will find that the difficulty he already knows with his pamphlet problem increases. This problem is already supplemented by that of provision for books on film. How may the different forms of written material entrusted to the librarian's care be most conveniently and economically preserved? What are the costs of keeping this material in suitable condition for continued use?

Materials to be stored by libraries fall into four classes: bound books, pamphlets, loose-leaf material, and film strips. It is safe to say that any document that is more than half an inch thick is likely to be bound and treated as a book. Documents of less than that thickness may be shelved in pamphlet binders or combined in groups to form volumes of ordinary book size. An alternative treatment is that used for loose-leaf material, that is, to store them in vertical filing cases with folders and guides to make them easily accessible, or to lay them in manuscript boxes to preserve them as safely as possible. Microcopied material in the form of film rolls may be kept in small boxes, labeled and shelved like books. Three types of costs appear here: filing, binding, and library shelving. The latter are discussed in Chapter II.

Vertical Filing

The vertical filing system, rather than ordinary library shelving, is used for the temporary storage of items of pamphlet or typescript memorandum size. When a considerable volume of this material accumulates, two alternatives present themselves. If the vertical file system is adopted for the permanent storage of pamphlets and typescript, the library pays at the rate of $5.00 or $6.00 per 1000 pages for storage equipment. If the accumulation is bound as periodicals are bound, when enough articles on a subject have been brought together, the cost of binding the contents of a file drawer in books averaging one inch in thickness would be from $20.00 to $30.00; in books averaging four inches in thickness, it would be from $10.00 to $20.00, with a button binding being used. The choice between these two courses depends as much upon the nature of the material itself as upon cost considerations.

Binding: (a) Vertical File Material

A simple form of binding used for vertical file material up to forty or fifty pages in length is wire stapling. This is done with the small stapling machine, costing about $5.00, that is part of standard office equipment. The cost is almost exclusively a labor cost. 5000 staples can be purchased for $2.00. A worker can staple about 500 to 600 documents an hour at a labor cost of $.40. Wire stapling by a commercial service shop costs about $.02 a copy. Machine stapling, including a suitable paper cover, is available at a cost of a few cents a copy. This will take care of items up to 1/4" in thickness. Wire stapling through the fold is not suitable for ordinary typescript on typescript paper, but it can be used for any printed or photo-offset items published in one signature of sixteen or thirty-two pages.

Spiral binding is a form of notebook binding that is becoming increasingly popular for vertical file material. It first appeared a few years ago in Europe and was introduced in America through an American magazine. It is used for pamphlets and catalogues in Europe and for small edition publications. Loose sheets are held together by rings as in the simplest loose-leaf notebook style, but instead of two or three heavy rings, a series of thin wire ones is fastened along one side of the sheets to be bound together. The advantages are that the book lies perfectly flat, is absolutely flexible, the inside margins are not obscured in any way, and there is no trouble with a double spread of page. The price is determined by two factors: quantity and length of the side to be spiral bound. An 11" side, which is the common one used in schools, in quantities of 1000, with each copy 1/4" in thickness, would cost approximately $50.00. The price goes down as the quantity increases, 2500 copies getting a 10% discount; 10,000 having a 20% discount, etc.

Spiral binding has not been unanimously approved by librarians. They claim that it is hard to keep on the shelves and needs more storage space. Also, there is no place on the back of the book for title, author, or reference number; and this makes it necessary to take each spiral-bound item off the shelf to ascertain if it is the desired copy. The Spiral Binding Company suggested the use of labels, to be pasted on the shelves immediately below the books in question. The question of permanency was also raised by the librarians. In answer to this, tests were made between spiral binding and thread-sewn books that seemed to prove that sheets could be pulled out of thread-sewn books more easily than out of spiral-bound books. The number of rings tends to make a stronger binding. An example of its use may be found in Dr. Charles C. Peters' thesis material, which has been published in reduced-size offset.

Binding: (b) Pamphlet and Periodical Material

For items of pamphlet thickness, four binding techniques are available: namely, the spiral binding and the stapling mentioned above, pasting, and wire stitching. Pasting, next to stapling, is the simplest method of fastening sheets of a pamphlet together, one fold inside of another. This method, however, is for binding only a few sheets and is for very temporary work.

There are two common methods of wire stitching: saddle- and side-wire stitching. With saddle-wire stitching, the pamphlet is opened in the middle and layed face down (or face up). The stitching is done on a machine which holds a spool of wire from which staples are made and driven through the sheets in the fold and clinched on the other side. Side-wire stitching is the same method, except that the stitching is done through the side of the collected sheets instead of through the fold. Saddle-wire stitching is used when sheets are folded as one signature; side-wire stitching is used when two or more signatures are gathered side by side. Wire stitchers can be used for items up to 1/2" in thickness.

Pamphlet producers, like periodical publishers, usually pass their binding costs on to the library. Library binderies have attained a distinct recognition in the bookbinding industry in recent years, and are now considered as being a separate branch of bookbinding. The United States Census Bureau, in its 1925 statistical report on the binding industry, put library binderies in a class by themselves. The American Library Association in 1922 had a meeting with the Employing Bookbinders of America and the two groups drew up some principles to be observed in library bookbinding.

The library, in assuming the costs of pamphlet and periodical binding, sometimes puts them in separate bindings, but usually groups them and binds them into volumes for reference. The publishers of periodicals generally have the responsibility of determining how many issues of a magazine constitute a volume. Monthly school magazines, usually issued ten times a year, form a volume for each ten numbers; magazines issued each month during the year generally form a volume every six months. Extra thick volumes of magazines and newspapers must receive special care and usually have to have reinforcement in the form of a strong lining or back strip. If the periodical or pamphlet producer uses a sufficiently heavy cover stock, he can save the library the extra cost of pamphlet care that is involved in fitting pamphlets into binders.

The only justification for transferring the cost of adequate binding to libraries is a situation in which a substantial proportion of an edition is distributed to users who will not require that it be well bound. If an entire edition of a pamphlet is to go to libraries which will catalogue and shelve it, it might as well be bound with boards heavy enough to sustain library use. If, on the other hand, the edition is to go principally to users, whether libraries or individuals, who will put it in a vertical file, the heavy cover boards are not only an unnecessary cost, but an actual disadvantage.

Binding (c) Bookbinding Techniques[1]

In the case of books of full standard thickness, saddle stitching, side stitching, and sewing are most commonly used. With side stitching, the pages do not lie flat when opened, but must be held open; sewed and saddle-stitched books lie flat and show the full inside margin.

Side stitching is done by making small holes in the sheets near the back and passing the thread through these holes. If the stitching is done by machine, punches are used to make the holes.

Saddle stitching is done through the folds of the signatures. The stitches are made long to prevent weakening of the book by too much perforation. Usually a strip of muslin or crash is glued on the back for reinforcement.

In sewed books (and the great majority of books are sewed) each signature is sewed to its neighbor, so that an unlimited number of signatures may be contained in a book. These signatures are piled together and cords or tape are fastened crosswise across the back in grooves made for the purpose and fastened in the grooves by kettle stitching. The usual number of cords used is five. The finished product is a flexible and strong piece of work. When the signatures have been gathered and sewed, the edges are trimmed and the back rounded and reinforced with muslin or crash. It is during this reinforcing process that the headbands are added. Then the filler is ready for its cover and the finishing steps.

Paper is an important factor in binding and should be flexible in proportion to its size. When the grain of the paper runs the same way as the binding edge, the book will lie flat when opened; if the grain runs crosswise of the binding edge, the book will not lie flat when opened, but will be stronger. In handmade paper, the fibers run in all directions, so the paper is equally strong in any position.

Binding: (d) Bookbinding Costs

There are many factors aside from the technique of binding that determine the cost of bookbinding, which is fundamentally a running cost in book production, as it increases with the size of the edition. The most important factors are: (a) size factors: number of pages, signatures, and copies, and the size of the book; (b) materials factors: weight of paper, number of cords or tapes used in sewing, kind of cover material (leather, imitation leather, buckram, cloth, or paper); (c) style factors: headbands, treatment of corners (round or square), treatment of fly leaves (tipped or turned), stamping or lettering, and treatment of illustrative material (signatures or single pages, placed at end of book of interleaved with text).

Though it is obviously insufficient to speak of an "average" library book, nevertheless, a sample quotation on the cost of bookbinding in a style suitable for library shelving will illustrate the general cost level. The costs, as shown in Table XXXVI on the following page, are based on a good library binding of cloth vellum, linen finish.

The cost of binding newspapers or large quantities of typescript (such as the NRA hearings) enters into the cost analysis that will help determine whether such materials should be preserved by binding and shelving or in microcopy form. It is significant that the costs of binding a year's issue of a newspaper like the New York Times (approximately 20,000 pages, twenty-four volumes) amounts to $54.00, and storage costs would be from $48.00 to $72.00, while the cost of storage space required for the film copy of the same material would be about $1.50.

Film Storage

There are three ways of storing microcopied material on 16 mm. or 35 mm.

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[1] For excellent articles on binding, the reader is referred to The American Printer, December, 1932, pp. 36-38; also January, 1933 and July, 1933, p. 17.

TABLE XXXVI

COST OF A GOOD LIBRARY BINDING FOR A BOOK 1 1/2" THICK

A. Edition Costs

Page Size	Edition Size						
	25	50	100	250	500	750	1000
6" x 9"	$24.50	$41.50	$73.00	$145.00	$240.00	$322.50	$380.00
8 1/2" x 11"	25.00	42.50	75.00	150.00	250.00	337.50	400.00

B. Unit Costs

Page Size	Edition Size						
	25	50	100	250	500	750	1000
6" x 9"	$ .98	$.83	$.73	$.58	$.48	$.43	$.38
8 1/2" x 11"	1.00	.85	.75	.60	.50	.45	.40

film strips. They can be mounted flat, stored in rolls, or on spools. Flat mounting on cards (suggested by Mr. Atherton Seidell) is adapted only to very short strips, no wider than a card used in a vertical file system--hence 5" to 11" is a maximum length of strip. Roll storage is adapted to the lengths such as those produced in the Leica or EKA camera--5' to 15'. The separate lengths of film are placed in receptacles which may be either small tin pill boxes or larger partitioned metal or paper boxes holding twenty-five rolls of film. The longer rolls of film require spool storage. The Recordak Corporation furnishes spools with its film. Each spool will hold 200 feet of film; it fits in a cardboard box 4" x 4" x 1".

It is not known with certainty how much special care of atmospheric conditions is necessary in the preservation of the ordinary cellulose acetate "safety" film used in copying documents. The research under way at the Bureau of Standards will result in information upon this important cost factor in film storage. The storage of nitrate films is very expensive because of fire hazards; the storage of cellulose acetate films is not complicated by any fire hazard.

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"All the News That's Fit to Print."

The New York Times.

LATE CITY EDITION
WEATHER—Rain today; tomorrow fair and much colder.
Temperatures Yesterday—Max., 44; Min., 32.

Copyright, 1932, by The New York Times Company.

VOL. LXXXII....No. 27,328.
[redacted] Second-Class [redacted], Postoffice, New York, N. Y.
NEW YORK, SATURDAY, NOVEMBER 19, 1932.
* * * * +
TWO CENTS In New York City | [redacted] CENTS Within [redacted] Miles | FOUR CENTS Elsewhere Except in 7th [redacted] 8th Postal Zones

LAMONT CALLS FOR REFORM UNDER FEDERAL RESERVE TO STABILIZE BANK SYSTEM

FOR WIDE BRANCH BANKING

Wants All Commercial Units Brought Under Federal Rule.

ADVOCATES MERGER POLICY

4½ Times [redacted] Many Failures Outside Reserve System [redacted] In It, He Reports.

WORST PAST, SALTER SAYS

Revision Downward of Debts and Tariffs Is Urged Before Political Science Group.

[redacted] of Thomas W. Lamont's speech last night is on Page 8.

Thomas W. Lamont of J. P. Morgan [redacted] Co. told the Academy of Political Science at its annual dinner in the Hotel Astor last night that two vital changes were needed [redacted] primary steps for banking reform in the United States—to bring all commercial banks, large or small, under the Federal Reserve System and to establish "sensible" provisions for regional branch banking. If such reforms were brought about gradually, he asserted, they should result in "some measure of banking stability."

Pointing to the fact that 60 per [redacted] of the country's banks, with resources of [redacted] than $12,000,000,000, [redacted] outside the Federal Reserve System, the banker declared that no banking system can function adequately with only [redacted] limited number of banks within it. He asserted that despite the great number of bank failures in recent years, the country still has too many banks, and that "thousands of banks lack proper safeguards." Banking units should be larger than they are, he went on, and small, ill-capitalized institutions should be merged to gain the advantages of larger banks.

[redacted] Failures in Rural Districts.

Mr. Lamont emphasized that nearly four and one-half times [redacted] many non-member banks have failed [redacted] members of the Federal Reserve. [redacted] of these failures, he went on, were small country banks, under no control from the Federal Reserve and with such small paid-in capital [redacted] to [redacted] "subject to impairment under the most ordinary conditions of difficult times." Ninety per cent of the banks that failed between 1921 and 1930, he continued, were in rural communities, "subject to the vicissitudes of crop failures or of the expansion and deflation of business booms, without any of the protection afforded by a parent institution fortified with ample capital and managed by experienced men."

Almost all of the failures of small suburban banks around Chicago this year, Mr. Lamont asserted, could have been avoided if the Illinois laws had permitted branch banking. He said that the lessons must be obvious of [redacted] situation in which it was impossible under the law for the large Chicago banks to serve the suburbs through branch banks.

Mr. Lamont said that mismanagement of large city banks, although there had been striking instances of it, was rare compared to mismanagement of country banks. It was the weaknesses in the rural banks that led to hoarding [redacted] [redacted] grand scale last year, he declared. He went on that the need last year [redacted] not for currency, but for credit aid, but that sound credit risks were not available for the banks because of the deflation in security and commodity prices. There had never been a time, he said, when the facilities of the Federal Reserve System had not been more than ample to meet all legitimate credit needs.

Confusion in Banking Laws.

Laxity in granting charters to banks and [redacted] supervising their conduct, Mr. Lamont continued, was a result of the confusion due to the varying Federal and State banking laws, giving forty-nine different sets of banking laws.

Mr. Lamont asserted that the Fed[redacted] Reserve System had brought "immeasurable benefits" to Ameri[redacted] industry and commerce and that our plight would have been much [redacted] without it. The system's open-market policy during the past six months, he said, had proved [redacted] great

Continued [redacted] Page Eight.

BRIARCLIFF Lodge, Westchester. Ideal for Thanksgiving. Attractive rates; including golf, horses.—Advt.

Lamont Says Nothing Can Drive United States Off Gold Basis

Thomas W. Lamont, in his address on banking reform at the dinner of the Academy of Political Science at the Hotel Astor last night, declared that the United States had never been close to abandoning the gold standard. His words on this were:

"Finally, it has been the Federal Reserve System, and the wise conduct of it under the leadership of the Federal Reserve Board at Washington, and of the twelve regional banks, that have maintained impregnable for our country the sound, gold standard dollar. Remember this, my friends: among all the alarums and excursions of the last twelve-month we have never been near the point of abandoning the gold standard. Nothing [redacted] or will drive [redacted] from that standard. A Democratic administration, just like the steadfast Republican one before it, will continue to uphold the complete integrity of it. Make no mistake; in a dark and troublous world America and the American dollar [redacted], [redacted] to material factors, the safest things in all the world to tie to."

CABINET AGREES ON RETRENCHING

Deferring Decision on Tax Rise, President and Advisers Map $500,000,000 Federal Saving.

TO BALANCE BUDGET IN 1934

Congress Leaders and Chamber Group Put Economy First—Labor Fights Sales Levy.

Special to [redacted] New York [redacted].

WASHINGTON, Nov. 18.—While President Hoover and his Cabinet struggled today with the problem of reducing expenditures so that heavy additional tax levies would be unnecessary, members of Congress, discussing the situation, expressed hope that such a solution could be found.

One point [redacted] definitely established, following the meeting of the President and his advisers, namely: that reports that the administration would recommend [redacted] program of retrenchment for the fiscal year 1934 to the extent of $500,000,000 were accurate. Decision was deferred [redacted] whether a formal recommendation for tax legislation in the short [redacted]sion of Congress also would be necessary.

Details of the retrenchment program were withheld, but it [redacted] known that the appropriations sought by every department are being carefully analyzed and that [redacted] definite plan to bring the budget to a balance in 1934 will be placed before Congress to accept or reject.

It is understood also that the difficulties of budget balancing for the current fiscal year [redacted] considered virtually insurmountable, even if [redacted] taxes are levied which would be effective in the remaining seven months.

Economy Preferred to Tax Rise.

The general attitude of members of Congress was to withhold [redacted] definite statement [redacted] to the necessity of new taxes, pending recommendations from the executive branch.

Senator Harrison, ranking minor-

Continued [redacted] Page Four.

HOOVER WORKS OUT A DEBT PLAN TO LAY BEFORE ROOSEVELT

He Confers With [redacted] and Roop on Problem, but Aims Remain Undisclosed.

GOVERNOR'S IDEAS AWAITED

President-Elect's Hotel Reservations Indicate Plan to Stay Beyond Tuesday.

CONGRESS CHIEFS ADAMANT

Group Called to White House Oppose Reopening of Funding Commission Question.

Special to The New York Times.

WASHINGTON, Nov. 18.—President Hoover gave intensive consideration today to the war debt suggestions which he will submit to Governor Roosevelt at their conference next Tuesday, but how far he will go in proposing [redacted] new approach to the problem remained undisclosed.

Dividing his time between war debts and the framing of the budget, Mr. Hoover held a long session with his Cabinet this morning, and this afternoon conferred [redacted] war debts, first with Secretary of State Stimson and then with Secretary Mills and Director Roop of the budget. Afterward it [redacted] stated authoritatively that the President would have [redacted] debt plan to submit to the President-elect.

The question of how far [redacted] will [redacted] prepared to go with his views, however, it [redacted] said, undoubtedly would depend upon whether Mr. Roosevelt has definite proposals to offer or whether, in the absence of any definite suggestions, he will be prepared to approve, perhaps with modifications, the proposals of the President.

Roosevelt Ready for Longer Visit.

A possibility that the discussions between Mr. Hoover and Mr. Roosevelt might extend beyond Tuesday developed today when the Mayflower Hotel announced that Governor Roosevelt would stay there and [redacted] [redacted] arrangements "definitely" to remain over Tuesday night. He has not set any time for his departure from Washington, it [redacted] added, "in the event the war debt discussions with President Hoover at the White House continue for several days."

Reservations also have been made at the Mayflower for James A. Farley, chairman of the Democratic National Committee; Frank C. Walker, its treasurer, and Professor Raymond Moley, the President-elect's adviser on economic affairs.

Should the discussion between the President and the President-elect get nowhere, it [redacted] felt [redacted] political circles here that the conference Mr. Hoover has called for Wednesday with leading members of the Senate Finance and the House Ways and Means Committee may provide a lead for some affirmative approach to the debt question.

In the absence of any direct word from the White House or Albany, sentiment in Congress appeared today to be as firmly opposed to the re-creation of the Debt Commission for re-examination of the debtor governments' capacity to pay [redacted] it is to the suspension of the Dec. 15 payments.

Most Senators were of the opinion that President Hoover would suggest [redacted] revival of the Debt Commission, and they not only promptly declared against such [redacted] course but insisted that they would stoutly oppose any [redacted] for deferring of the Dec. 15 interest payment.

Senator Borah, chairman of the Foreign Relations Committee, however, thought that the President, after his talk with President-elect Roosevelt, would make [redacted] new pro-

Continued on Page Six.

Marciante Boy, Kidnapped Nov. 7, Returned; Lad Coached, Police Say; Crain Inquiry Today

Three kidnappers who kept Paul Marciante, 10 years old, of 315 East Sixtieth Street, [redacted] prisoner after making off with him Nov. 7 when he [redacted] [redacted] the way to school, released him about 9:40 o'clock last night, letting him out of [redacted] automobile at First Avenue and East Thirty-first Street. Exactly three hours later, after telling [redacted] story of being held in [redacted] three-[redacted] tenement flat and playing rummy with his abductors to [redacted] the time, he [redacted] taken under police guard, over the protests of his parents, to the Children's Society at Fifth Avenue and 105th Street to spend the night.

Deputy Inspector John P. M. Griffith said the boy [redacted] "obviously schooled" in his answers to questions put to him in the East Sixty-seventh Street Station and that [redacted] had been unable to give "adequate" descriptions of his three abductors, each of whom went [redacted] the [redacted] of "Jake."

The boy's father, Vincent Marciante, who went with his grief-prostrated wife to the police station when the boy was taken there, stoutly denied that he knew the kidnappers, even though the police believed he did and he insisted that he had not paid any ransom. Deputy Inspector Griffith hinted that "I might [redacted] who the kidnappers are, but it is not [redacted] police officer's duty to guess." When asked if he believed the father's assertions, he replied only, "Well, he says [redacted]o."

Griffith added that all the data in the [redacted] would be turned over this morning to the District Attorney. He said the child [redacted] taken to the Children's Society Shelter "because of the seriousness of this case."

When the boy [redacted] released he walked a short distance to [redacted] grocery store of his uncle, Paul Angello, at [redacted] East Thirty-first Street. From what the police could make of his story, it was believed he had been held in an apartment of two [redacted] and a kitchen somewhere in the city.

Prayer Invoking Help for the 'Forgotten Man' Used by Roosevelt [redacted] Proclaim Thanksgiving

Special to The [redacted] York Times.

ALBANY, Nov. 18.—Franklin D. Roosevelt in his Thanksgiving Day proclamation as Governor today called for special consideration for those in distress, including in it [redacted] prayer from the Episcopal Book of Common Prayer which mentioned the "forgotten man."

"Remember in pity," says the prayer, "such [redacted] are this day destitute, homeless [redacted] forgotten of their fellow-men."

This petition was chosen because it contained an appeal the Governor thought most appropriate to these times. His proclamation read:

> I, Franklin D. Roosevelt, Governor of the State of New York, do proclaim Thursday, the twenty-fourth day of November, in this year of our Lord one thousand nine hundred and thirty-two, [redacted] Thanksgiving Day.
>
> I ask the people of the State to come together in families, in communities and in churches for the giving of thanks to God.
>
> May the many of our people fortunate in their temporal well-being, and the many who are bearing the stress of poverty, unite in the com[redacted] purpose of seeking divine guidance toward the greater [redacted]tending of unselfish charity and help in behalf of their fellow-men.
>
> It is fitting that men [redacted] [redacted] of all creeds should join [redacted] the words of the prayer:
>
> "O God, almighty and merciful, who healest those that are broken in heart, and turnest the sadness of the sorrowful to joy; let thy fatherly goodness be upon all that thou hast made.
>
> "Remember in pity such [redacted] are this day destitute, homeless or forgotten of their fellow-men. Bless the congregation of thy poor. Uplift those who are cast down. Mightily befriend innocent sufferers, and sanctify to them the endurance of their wrongs.
>
> "Cheer with hope all discouraged and unhappy people, and by thy heavenly grace preserve from falling those whose penury tempteth them to sin; though they be troubled on every side, suffer them not to be distressed; though they be perplexed, save them from despair."

WENDEL 'SONS' CLAIM REJECTED AS FRAUD

Foley Throws Out Morris Case—To Send Record to Crain for "Immediate Action."

AUTHOR OF PLOT A MYSTERY

Surrogate Rules After Wedding Certificate of "1876" Is Proved Forgery Printed After 1913.

The claim of Thomas Patrick Morris, Brooklyn house painter, to filial kinship with John G. Wendel and through that to rightful ownership of the $30,000,000 Wendel estate was thrown out [redacted] "false and [redacted] forgery" by Surrogate Foley yesterday. Surrogate Foley announced he would send the record to District Attorney Crain, with the hope that it would "receive prompt attention."

Indignant that such [redacted] could "come into court rooms," Surrogate Foley with [redacted] bang of his gavel put [redacted] end to [redacted] claim once described by Arthur Garfield Hays, attorney for other Wendel claimants, [redacted] the "most interesting court room mystery of our time."

Attorneys for Morris and for the estate of Miss Ella [redacted] E. Wendel, the last of the Wendels, who successfully fought the claim brought by the elderly and ailing Scotsman, joined last night in wondering if [redacted] mystery of who prepared his claim would ever [redacted] unraveled. They [redacted] agreed that Morris had not been the author of the documents produced by him or in his behalf.

John [redacted] Harlan, trial counsel for the estate, which Miss Ella Wendel left to various charitable institutions, ended the presentation of evidence yesterday by proving that the marriage certificate purporting to attest the wedding of John G. Wendel and Mary Ellen Devine at Castle Garden on June 11, 1876, had been printed by the A. J. Holman Company of Philadelphia makers of Bibles, not earlier than 1913 and not later than 1923.

[redacted] evidence was put in through the testimony of Elbridge W. Stein, an examiner of questioned documents of many years' court experience. Mr. Stein showed how, through microscopic and stereoscopic examination of the certificate, together with many other similar certificates printed by the [redacted] company, he had come to his conclusion.

Traced Through the Years.

William K. Holman, head of the house founded by his grandfather, identified the certificate by Morris [redacted] one of [redacted] type which the publishers had begun including in their family Bibles in 1885. Through him Mr. Harlan introduced fourteen large Bibles, printed in varying years from 1873 to 1923, in each of which was [redacted] marriage certificate.

Then Mr. Stein traced through these certificates the deterioration of the plates from which they had been printed. As the electrotype was used more and more, it became [redacted] and more imperfect. Microscopic examination, presented through enlarged photographs, showed parts of letters chipped in some places, worn away in others, with various other disarrangements of the typographical layout of the certificate.

Mr. Stein analyzed particularly the worn places [redacted] a certificate printed in 1913. Then, taking up the Morris certificate, he showed every worn or defective mark found on the 1913 certificate. [redacted] jumped then to [redacted] and showed that [redacted] the Morris certificate there appeared other imperfections which [redacted] again visible on the 1923 certificates, but which had not developed in 1913.

In this way the date of the printing

Continued on Page Three.

ROOSEVELT HEARS 'HUNGER MARCHERS'

Surprises Delegation of Three by Listening to Pleas and Debating With Them.

THEIR DEMANDS REJECTED

As "Private Citizen" He Can't Tell Hoover to Clear Their Way—Holds State Aid Adequate.

Special to [redacted] New York [redacted].

ALBANY, Nov. 18.—Franklin D. Roosevelt surprised three "hunger march" leaders today by receiving them readily in the quiet of the Executive Mansion study and reasoning with them calmly about their demands.

Gathered in [redacted] semicircle before him, the men, one with his collar open at the neck, found the Governor ready to match statements with them in an even-tempered but firm manner.

Secret Service men, guarding him [redacted] President-elect, were [redacted] by as Mr. Roosevelt talked with the "marchers," who by their [redacted] admission belonged to [redacted] group which invaded the Legislature last year.

Three main demands [redacted] presented by the delegation: A special session of the Legislature to appropriate $100,000,000 for immediate help to the unemployed; an order throwing open all the armories in the State, and provision of food and transportation for [redacted] "hunger march" to Washington, and [redacted] guarantee that the marchers would not be molested by the police of New York cities.

All of these were rejected by the Governor. When he [redacted] asked to "tell President Hoover to let them [redacted] to Washington without any interference," he replied emphatically:

"I am just [redacted] private citizen and I cannot tell the President to do anything."

[redacted] of the Delegation.

The delegation was composed of two New Yorkers, Sam Wiseman, chairman, and Richard Sullivan, secretary of the conference for Winter relief, and Milton Stone of Schenectady, chairman of the New York State "hunger marchers."

When word reached Albany Police Headquarters that the men were on their way here, [redacted] cordon of local police had been sent to guard the Executive Mansion, but no trouble of any kind arose.

They had arrived about noon and it was obvious from their manner that they hardly expected [redacted] conference with the Governor. Since his election to the Presidency very few visitors have crossed the threshold.

On hearing the mission of the three, the Governor almost at once directed that they be brought to his study. The secret service [redacted] assembled, [redacted] they always do when [redacted] delegation calls, and [redacted] few minutes later the newspaper men were invited to sit in on the conference.

Leaning forward in his chair Mr. Roosevelt listened carefully as the three spokesmen voiced their views. He continually challenged the accuracy and reasonableness of their statements, but did [redacted] almost without lifting his voice.

As they told of their plans, he remarked:

"Every person has [redacted] perfect right to travel. Naturally the Governor hopes that the police throughout the State will exercise humane methods and give fair treatment."

"Yes," retorted Stone. "We got fair treatment on March [redacted] two years ago."

He [redacted] referring to the disorder when [redacted] group of alleged Communists invaded the Legislature to demand relief appropriations. Several per-

[redacted]

ROOSEVELT SUPPORT IN PRIMARY IS HELD VITAL IN M'KEE FIGHT

Acting Mayor's Chance Viewed [redacted] Slight Unless New President and Flynn Aid Him.

FUSION MOVEMENT GAINS

J. M. Price, Backer of Mitchel in 1913, Calls [redacted] Meeting to Organize [redacted] Campaign.

ENDORSEMENT BY KRACKE

Republican Leader in Kings Says Party Is Ready to Support Acting Mayor's Candidacy.

The fusion movement looking toward Tammany's overthrow in the 1933 Mayoralty election continued to grow yesterday, but the situation [redacted] complicated by the possibility that the real fight for control of the city government might be waged in the Democratic primary next September.

That fight could be made, in the opinion of political observers, only if Franklin D. Roosevelt used his position and prestige [redacted] President to back an anti-Tammany Democratic movement here, [redacted] movement that would have as its nucleus the Bronx organization of Edward J. Flynn.

It would depend [redacted] well, it [redacted] said yesterday, on the winning to the Roosevelt camp of John H. McCooey, Brooklyn leader, and the breaking up of the McCooey-Curry alliance.

Joseph M. Price, [redacted] official of the City Club of New York and an organizer of the movement in 1913 that resulted in the election of John Purroy Mitchel, announced that a meeting had been called for Nov. 28, to be held at the City Club, to gather under one central committee the anti-Tammany elements. He emphasized that it merely would be [redacted] committee to organize a fusion movement, and that it would not seek to pick [redacted] candidate for many months. Others stressed the danger of committing the fusion movement to the candidacy of any man at present.

Among those who have already said they would attend the conference at the City Club are Charles C. Burlingham, Henry De Forest Baldwin, Frederick L. Cranford, Bernard S. Deutsch, Leo Arnstein, Kenneth Dayton, Kenneth M. Spence, Stanley M. Isaacs, Stuart Hirschman, Raymond V. Ingersoll, Cyrus C. Miller, George McAneny, Lewis H. Pounds, Robert E. Simon, Martin Saxe and Oswald Garrison Villard.

Tammany Not Alarmed.

Tammany [redacted] expressed confidence yesterday that Mr. Roosevelt would keep hands off the city situation, and that even if he did not, Tammany could easily win in any Democratic primary. Friends of Mr. Roosevelt remarked only that it [redacted] far too early to predict how he would deal with the organization that first opposed him bitterly and then helped give him [redacted] large plurality in the city. The tendency among vet[redacted] in city politics yesterday [redacted] to regard the picking of Acting Mayor Joseph V. McKee as a fusion candidate now or the selection of any one else, with the primaries ten months away, [redacted] premature.

Endorsement of Mr. McKee [redacted] the fusion candidate next Fall [redacted] yesterday from Frederick J. H. Kracke, Republican leader of Kings County. Samuel S. Koenig, New York County leader, has already endorsed Mr. McKee, and Warren B. Ashmead of Queens has approved.

"The Republican organization was ready weeks ago to make Mr. McKee its candidate for Mayor," Mr. Kracke said. "I am sure that it will be ready again when the time [redacted]

Continued on Page Three.

Germans Fear Loss of Brewmasters to Us And of Waitresses Who Can Carry 24 Steins

Special Cable to The New York Times.

MUNICH, Nov. 18.—Whether there will soon open [redacted] market for German beer in United States concerns the Bavarian brewery owners less than the danger of [redacted] exodus of experienced brewmasters to that country.

With the export outlook still [redacted] [redacted] of froth, the heads of [redacted] big local beer plants seriously envisage [redacted] raid [redacted] their staffs of trained brewmasters, it being realized that twelve years' stoppage of production has left the United States short of trained hop and barley manipulators.

In [redacted] to such [redacted] menace, [redacted] brewery head said, there [redacted] also inquiries from New York for waitresses of the Hofbrau dynasty capable of negotiating twelve steins in each hand on each trip, [redacted] it is foreseen that speedy service will be demanded once the faucets [redacted] again legally opened.

[redacted] for early export prospects, the Munich and Nuremberg beer kings are indulging in no illusions, since they realize that, in addition to the constitutional hurdle, the probable duty [redacted] beer would make the capture of American markets impossible. Pre-war exports of beer from Bavaria to the United States did not reach any appreciable volume, and it is not expected here that future business, once the barriers [redacted] removed, will attain large proportions.

An American market will be welcomed, of course, but, [redacted] one brewer observed, "there seems to be a lot of muddled thought on the other side with reference to an early resumption of Bavarian beer exports, judging from the inquiries which pour in on [redacted] from many points in America."

This brewer is prepared to fill orders but warns the cost to the con[redacted] will be "tall, if the suds ever [redacted] their destination."

DRY AGENTS FIND ROBINS IN NORTH CAROLINA HILLS; CALLED AMNESIA VICTIM

ENCOUNTERED BY CHANCE

A Newspaper Photograph Led to Recognition of Man in Mountains.

LIVED AS A PROSPECTOR

Reverted to Klondike Habits After Disappearing Here on Way to White House.

IDENTIFIED BY HIS NEPHEW

Village Residents Say He Got Florida Paper and Spoke for Hoover.

Special to [redacted] New York Times.

ASHEVILLE, N. C., Nov. 18.—Colonel Raymond Robins, dry crusader and social worker, who disappeared Sept. 3 while [redacted] his way to confer with his close personal friend, President Hoover, has been found, Deputy Prohibition Administrator J. Ed Kanipe revealed tonight.

Seemingly physically sound, Colonel Robins apparently is suffering from amnesia, Mr. Kanipe said. When the missing [redacted] [redacted] found in the lonely mountain region of North Carolina he did not know his own identity, nor [redacted] be able to explain how he had reached there it is said.

Colonel Robins has been placed under proper medical care, Mr. Kanipe said. He was seen today by his nephew, John C. Dreier of New York City, who came here to identify him at Mr. Kanipe's request. After Mr. Dreier had confirmed the identification, Mrs. Robins was advised in Florida that her husband had been found, and is now on her way to him.

The nation-wide search undertaken by the Federal prohibition authorities and the Department of Justice when Colonel Robins disappeared in New York while on his way from his Summer home at Southwest Harbor, Me., to the White House was credited by Mr. Kanipe with his discovery.

In what [redacted] seemingly a reversion to his early prospecting days in Alaska, during the gold rush there at the close of the last century, Colonel Robins has been wandering through the mountains searching for precious metals, Mr. Kanipe said.

Known [redacted] 'Raymond Rogers.'

Under the name of Raymond Rogers, Colonel Robins has been living at a boarding house in the village of Whittier, in Swain County, about sixty miles from here. He made several speeches for President Hoover there during the recent campaign. He told some of his auditors that he was a personal friend of the President and also of his Democratic rival, Franklin D. Roosevelt.

Colonel Robins made many friends in the vicinity [redacted] he wandered about in his search for minerals. He dressed in rough clothing and grew [redacted] heavy beard. Despite this change in his appearance, his identity was suspected by two dry agents, Charles Dranton and Ray Bigges, who were in the neighborhood [redacted] routine duties and who chanced to encounter him. They had seen his picture in an Atlanta newspaper and thought they recognized him.

After they had communicated their belief to Mr. Kanipe, he sent to Washington for a better picture of the missing dry leader. When it arrived Mr. Kanipe decided that the likeness was [redacted] striking that he felt no doubt in his own mind that Colonel Robins had been found.

Placed Under Medical Care.

Taking personal charge of the search, Mr. Kanipe located the missing man yesterday, but because he was not [redacted] of the identification he made no announcement. He communicated with Mr. Dreier by telephone, and the latter came here at once.

Mr. Dreier's positive identification removed all doubts, and Mr. Kanipe late this evening made the following announcement from his office here:

"Colonel Raymond Robins was located in the mountains of Western North Carolina near Asheville yesterday. He [redacted] identified by his nephew, John C. Dreier of New York City, who [redacted] from New York for that purpose. He is in sound physical condition and in perfect control of the ordinary mental faculties.

"The Colonel [redacted] apparently suffering from amnesia and loss of memory, and has been spending the last

Continued on Page Two.

Woman Sought to Slay Papen, Sentence [redacted] Prison Reveals

By The Associated Press.

BERLIN, Nov. 18.—An attempt on the life of Chancellor von Papen on Tuesday was disclosed today when Mrs. Paula Budde was sentenced by [redacted] special court to three months' imprisonment for carrying [redacted] dagger.

She was arrested in the Chancellery on Tuesday when she sought [redacted] interview with Colonel von Papen. The Chancellor's secretary became suspicious and telephoned the police, who said they found [redacted] dagger [redacted] foot long concealed in her dress.

The woman's husband testified that she had told him she wanted to give the Chancellor [redacted] memorandum in the hope that he would change his political policies. News of the arrest [redacted] suppressed at the time.

VANDENBERG SWINGS TO VOTE FOR BEER

Senator to Obey "Undeniable Mandate" of Michigan Voters in Repealing State Dry Law.

POU READY TO OFFER BILL

Rules Committee Head Will Make It Special Order if Needed—Harrison Reiterates Stand.

Special to The [redacted] York Times.

WASHINGTON, Nov. 18.—Bowing to the mandate of his State, Senator Vandenberg of Michigan today joined those demanding immediate resubmission of the Eighteenth Amendment [redacted] immediate modification of the Volstead act.

The Senator said he considered the two-to-one vote of Michigan citizens against their own prohibition act "an undeniable mandate" which should be "validated at once."

"The vote repealing State prohibition in Michigan demonstrates that two out of three voters demand a change," Senator Vandenberg said. "These emphatic totals came from more than [redacted] majority of counties in all parts of the Commonwealth. The result is an undeniable mandate. For two [redacted] it should be validated at once:

"First, citizens who have spoken [redacted] convincingly are entitled as [redacted] right of popular government to the earliest opportunity to complete their conception of ordered temperance.

Fears Interlude of Chaos.

"Second, pending this conclusive action, there is [redacted] interlude of chaos which injects new infirmity into all law enforcement, precipitates new disputes over Federal and State cooperation, shatters morale, and encourages lawless and untaxed liquor latitudes. I favor immediate resubmission of the Eighteenth Amendment. A just regard for the rights of majorities and the validity of law enforcement demands it."

He added that the "repeal proposal should preserve Federal cooperation in protecting self-elected dry territory from wet invasion."

In conclusion the Senator said:

"I shall not vote to weaken the enforcement of the law as it exists at any given time. Whatever the law, enforcement is vital. It will be vital to any new order. The problem of liquor control is not ended by repeal.

Continued on Page Two.

FIGURE LIV

CHAPTER X

REDUCED SCALE PHOTOGRAPHIC AND PHOTOLITHOGRAPHIC COPYING ON PAPER, FOR READING THROUGH MAGNIFYING GLASSES

The predominance of area costs in the techniques employing the principle of photography furnishes a constant temptation to reproduce as large a number of words as possible on a given area. The ease with which an original copy can be reduced in size in the course of photographic reproduction increases the temptation, and the mathematical law that utilization of area increases by squares while reduction of linear dimension of the writing proceeds arithmetically clinches the economy argument in favor of reducing all texts to the smallest legible size.

Thresholds of Legibility

There are, however, three thresholds of legibility. The first and most important is the minimum that can be read easily with the naked eye. This minimum was placed, in an earlier chapter of the book, at seven-point (newsprint) type, or pica typescript reduced to 80% of full size. Below this minimum there is a range down to five-point type, or pica typescript reduced to 70%, within which writing is decipherable with the naked eye, though not easily legible. Within this range a reading glass will facilitate the reading. When still further reduced, writing is indecipherable with the naked eye, but legible with the reading glass or magnifying glass. However, as the size of the letters is diminished, a lens system with higher magnifying power than the ordinary reading glass is required, and the higher magnifying power brings with it a diminution in the field of vision. This hampers speed of reading and sets a limit to reductions that are to be read by direct magnification. Another limiting factor is the requirement that sufficient light must be reflected from the small area of paper that constitutes the field of the lens system. Ordinary light intensities that would suffice for comfortable reading with the naked eye do not adequately illuminate the greatly reduced area that is to be read with a magnifying glass.

If seven-point newsprint type is taken as the smallest type that can be read easily with the naked eye, then a 50% reduction of this type, can be read conveniently with the reading glass but not with the naked eye.[1] Below this level, it is possible that more elaborate reading glass systems may permit the reading of texts that have been copied with higher reduction ratios, perhaps as much as eight or ten diameters from pica typescript.

Beyond the limit set to reduction by these optical devices lies the zone in which a projector will yield a legible image. Applications of the projection system will be discussed in the next chapter.

The different zones in which these three methods--naked eye reading, reading glass reading, and projection reading--are operative can be charted as shown in Table XXXVII on the following page.

Reduced Size Newspapers

There have been several practical efforts to utilize these reductions in the reading glass zone. The Joint Committee coöperated with the New York _Times_ in an inquiry addressed to librarians as to whether they would prefer, for permanent preservation, the full-size rag paper copy of the _Times_ or a rag paper copy reduced one diameter by the photo-offset process. A majority of the subscribers to the rag paper edition expressed a preference for the small size copy because the advantages in storing and handling were deemed sufficient to compensate for the disadvantage in reading. A copy of a page of the _Times_ reduced to this scale is shown. But the response was not sufficient to warrant the company in shifting from the present rag paper edition to the reduced size edition. It appeared that, because of the additional expense, the company could find it possible

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1. See Figure XIII, a graph of legibility of newsprint in photo-offset reductions.

TABLE XXXVII

THRESHOLDS OF LEGIBILITY IN REDUCTIONS OF TYPESCRIPT AND NEWSPRINT

		Typescript	Newsprint	Naked Eye	Reading Glass	Projection
	Naked Eye Zone	Pica typescript full size. Pica typescript reduced to 80% of full size	Newsprint full size	Easy		
Reading Glass Zone		Pica typescript reduced to 70% of full size	Newsprint reduced 50%	Difficult	Easy	
	Projection Zone	Pica typescript reduced seven diameters, to 10%-14% of full size	Newsprint reduced 55%-65% of full size	Impossible	Difficult	Easy
		Pica typescript reduced twenty-two diameters, to 4½% of full size	Newsprint reduced sixteen diameters, to 6% of full size	Impossible	Impossible	Easy
		Pica typescript reduced to 4% of full size	Newsprint reduced twenty diameters, to 5% of full size	Impossible	Impossible	Difficult
		Pica typescript reduced to less than 3½% of full size	Newsprint reduced more than twenty-five diameters, to less than 4% of full size	Impossible	Impossible	Impossible

to make this shift only if a number of subscribers substantially greater than those now taking the rag paper edition would desire the reduced size edition.

Another plan for publishing newspapers in reduced size has been the subject of an experiment by the Millar Publishing Company, and has been tied in with the development of an interesting reading device manufactured by the Bausch and Lomb Company. This direct reading device consists of a lens, set in a frame, with a curved segment of a cylinder of optical glass mounted about two inches above it, and the whole system set on a swinging arm, made adjustable by means of a screw, to swing over the page at the proper distance for magnifying purposes. The magnification in this system amounts to about three diameters. The newsprint is reduced to approximately 33% of normal size. Experiments in the office of the Joint Committee indicate that this device is convenient and practical.

Peters' Miniature Abstracts and Theses

Another plan for utilizing these low reductions has been put into effect by Professor Charles C. Peters of the Pennsylvania State College in reproducing abstracts of theses of the Department of

Recto

PREFACE

During the past two years we published abstracts of theses at the Pennsylvania State College (Penn State Studies in Education No. 2 and No. 4) in such size and character that the pages could be filed in the Loyola Educational Digest. This year we are continuing that policy but carrying the development a step further, and we renew our invitation to other universities to join us in this plan of publication so that a better distribution of all worth-while studies on the science of Education may result.

Our abstracts this year are lithoprinted. That method makes possible copying the material directly from the typewritten copy by a photographic process. On one side of the page of each abstract we lithotype at a reduction of only forty percent in linear dimension (sixty-four percent in area), so that the material may be read without the aid of a magnifying glass. On the opposite side we lithotype in miniature, at a reduction of about ninety-five percent in area. These miniatured pages must be read with the aid of a good reading glass, several practical kinds of which are recommended below. The large-type page contains an abstract of such completeness as can be put on a single page, and constitutes all most readers will wish to know about the study. The miniatured abstract is independent of the large-type one and is for those whose interests or needs impel them to pursue the study further than the brief abstract permits. In each of these abstracts as published this year we include nine times as much material as we did in the printed ones published previously, yet the cost per abstract is less than half as much. In the miniatured pages constituting one abstract (covering one side of a 5"X8" sheet) we get a write-up that would occupy twelve or fifteen pages in an educational journal - a full-length article. Within this space we find that we can say all that needs be said about most types of theses; we can give all relevant material except the work-sheets and the summary of previous studies. It is, however, not enough space to permit an adequate account of an historical thesis, a documentary analysis, or most questionnaire studies.

This material was "copifyed" by The Copifyer Corporation, 2863 E. Grand Boulevard, Detroit. The cost of printing 600 copies of the 80 page set of abstracts was \$107. Two hundred and fifty copies were bound by the Spiral Binding Company at about five cents per copy, making the total cost about \$120. We chose the patented (wire coil) Spiral Binding for library copies because it permits the sheets to lie perfectly flat, which is a great advantage when the material must be read with a magnifying glass. The cost of this form of publication is so low that it is not unreasonable to hope that all universities receiving graduate theses or good seminar studies will come to this form of publication. The expense amounts to an average of only three dollars an abstract, which could be charged to the student if necessary.

In order to try out the maximum economy in this form of publication, we single-spaced our material in typing. Experience may prove double-spacing, or an intermediate step between single and double spacing, to be more desirable. Our material was typed

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1. Penn State maintains an exchange arrangement with about 100 university libraries, so that the reader may inspect this binding if his library is on our exchange list. Bound copies may be purchased from us at fifty cents each.

Verso

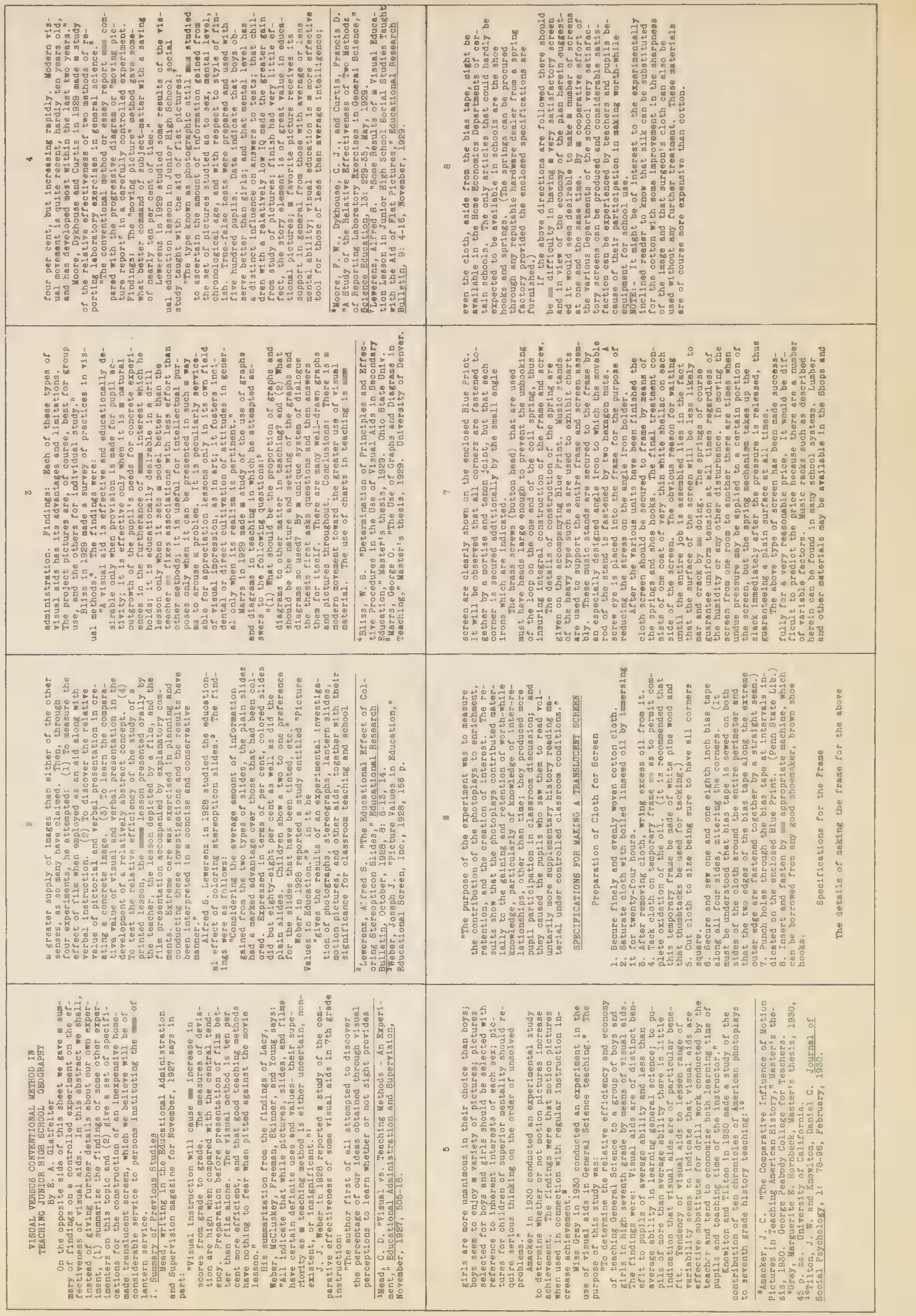


FIGURE LV

PHOTO-OFFSET REPRODUCTION OF PETERS' ABSTRACT METHOD

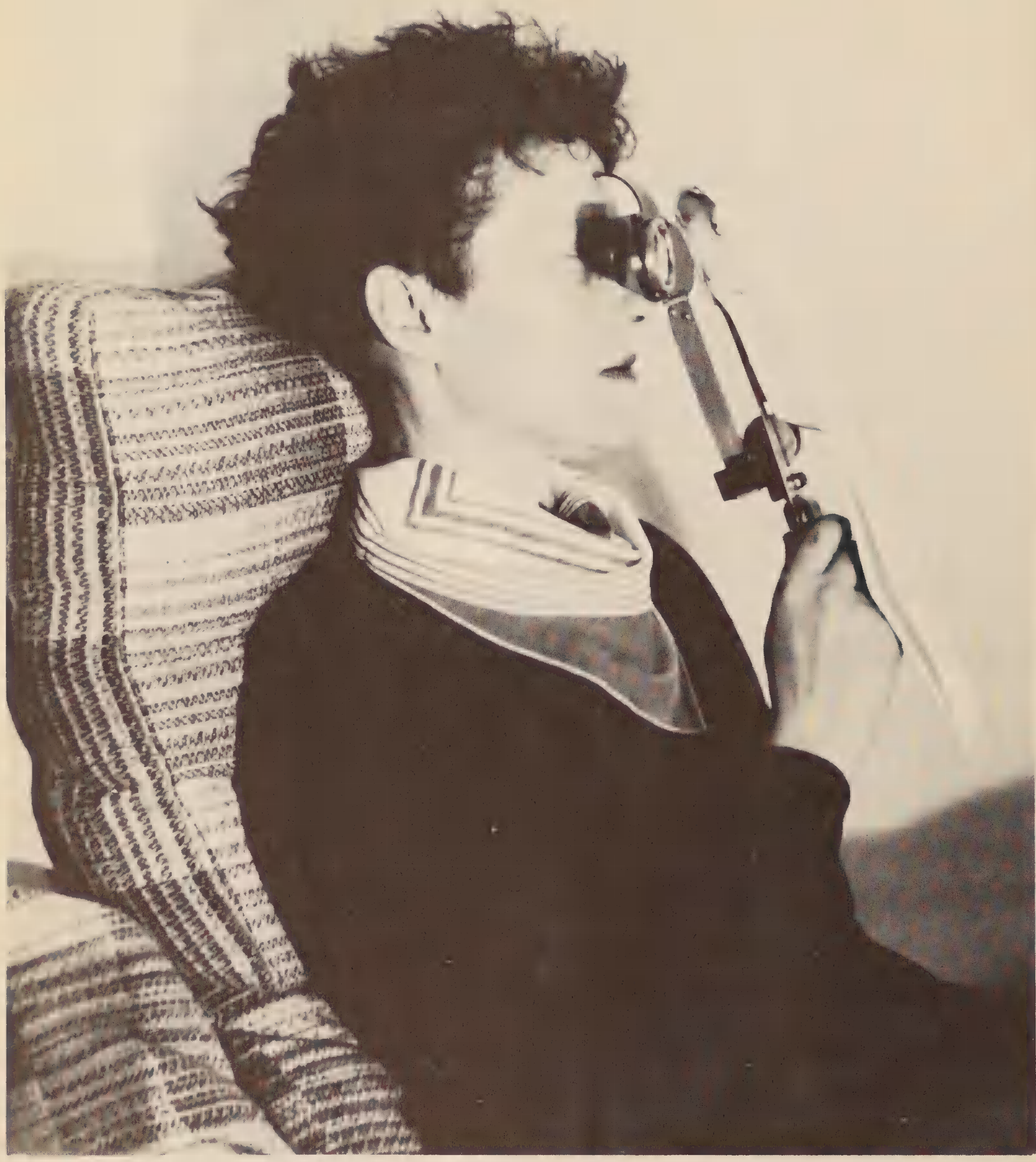
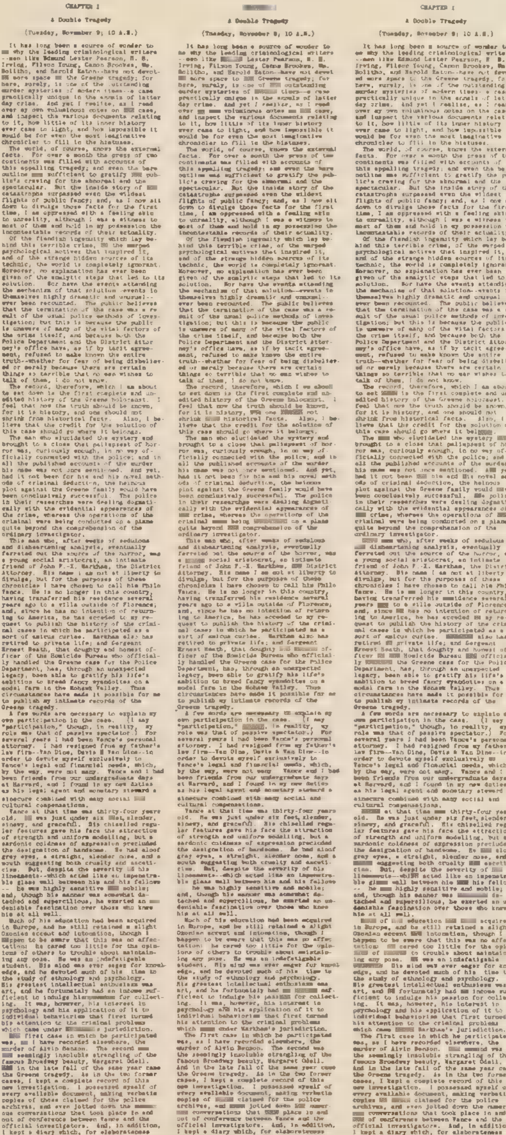


FIGURE LVI

The Fiskoscope

FIGURE LVII

FISKE READING STRIP



CHAPTER I

A Double Tragedy

(Tuesday, November 9; 10 A.M.)

It has long been a source of wonder to [redacted] why the leading criminological writers--men like Edmund Lester Pearson, H. B. Irving, Filson Young, Canon Brookes, Wm. Bolitho, and Harold Eaton--have not devot[redacted] more space [redacted] the Greene tragedy; for here, surely, is one of the outstanding murder mysteries of modern times--a case practically unique in the annals of latter day crime. And yet I realize, as I read over my own voluminous notes on [redacted] case, and inspect the various documents relating to it, how little of its inner history ever came to light, and how impossible it would be for even the most imaginative chronicler to fill in the hiatuses.

The world, of course, knows the external facts. For over a month the press of two continents was filled with accounts of this appalling tragedy; and even the bare outline [redacted] sufficient to gratify [redacted] public's craving for the abnormal and the spectacular. But the inside story of [redacted] catastrophe surpassed even the wildest flights of public fancy; and, as I now sit down to divulge those facts for the first time, I am oppressed with a feeling akin to unreality, although I was a witness to most of them and hold in my possession the incontestable records of their actuality.

Of the fiendish ingenuity which lay behind this terrible crime, [redacted] the warped psychological motives that inspired it, and of the strange hidden sources of its technic, the world is completely ignorant. Moreover, no explanation has ever been given of the analytic steps that led to its solution. Nor have the events attending the mechanism of that solution--events in themselves highly dramatic and unusual--ever been recounted. The public believes that the termination of the case was a result of the usual police methods of investigation; but this is because the public is unaware of many of the vital factors of the crime itself, and because both the Police Department and the District Attorney's office have, as if by tacit agreement, refused to make known the entire truth--whether for fear of being disbelieved or merely because there are certain things so terrible that no one wishes to talk of them, I do not know.

The record, therefore, which I am about to set down is the first complete and unedited history of the Greene holocaust. I feel that now the truth should be known, for it is history, and one should not shrink from historical facts. Also, I believe that the credit for the solution of this case should go where it belongs.

The man who elucidated the mystery and brought to a close that palimpsest of horror was, curiously enough, in no way officially connected with the police; and in all the published accounts of the murder his name was not once mentioned. And yet, had it not been for him and his novel methods of criminal deduction, the heinous plot against the Greene family would have been conclusively successful. The police in their researches were dealing dogmatically with the evidential appearances of the crime, whereas the operations of the criminal were being conducted on a plane quite beyond the comprehension of the ordinary investigator.

This man who, after weeks of sedulous and disheartening analysis, eventually ferreted out the source of the horror, was a young social aristocrat, an intimate friend of John F.-X. Markham, the District Attorney. His name I am not at liberty to divulge, but for the purposes of these chronicles I have chosen to call him Philo Vance. He is no longer in this country, having transferred his residence several years ago to a villa outside of Florence; and, since he has no intention of returning to America, he has acceded to my request to publish the history of the criminal cases in which he participated as a sort of amicus curiae. Markham also has retired to private life; and Sergeant Ernest Heath, that doughty and honest officer of the Homicide Bureau who officially handled the Greene case for the Police Department, has, through an unexpected legacy, been able to gratify his life's ambition to breed fancy wyandottes on a model farm in the Mohawk Valley. Thus circumstances have made it possible for me to publish my intimate records of the Greene tragedy.

A few words are necessary to explain my own participation in the case. (I say "participation," though, in reality, my role was that of passive spectator.) For several years I had been Vance's personal attorney. I had resigned from my father's law firm--Van Dine, Davis & Van Dine--in order to devote myself exclusively to Vance's legal and financial needs, which, by the way, were not many. Vance and I had been friends from our undergraduate days at Harvard, and I found in my new duties as his legal agent and monetary steward a sinecure combined with many social [redacted] cultural compensations.

Vance at that time was thirty-four years old. [redacted] was just under six [redacted]et, slender, sinewy, and graceful. His chiselled regular features gave his face the attraction of strength and uniform modelling, but a sardonic coldness of expression precluded the designation of handsome. He had aloof grey eyes, a straight, slender nose, and a mouth suggesting both cruelty and asceticism. But, despite the severity [redacted] his lineaments--which acted like an impenetrable glass wall between him and his fellows--he was highly sensitive [redacted] mobile; and, though his manner was somewhat detached and supercilious, he exerted an [redacted]deniable fascination over those who knew him at all well.

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The Greene murder case occurred toward the end of Markham's first year in office. As you may remember, the winter came very early that season. There were two severe blizzards in November, and the amount of snowfall for that month broke all local records for eighteen years. I mention this fact of the early snows because it played a sinister part in the Greene affair: it was, indeed, one of the vital factors of the murderer's scheme. No one has yet understood, or even sensed, the connection between the unseasonable weather of that late fall and the fatal tragedy that fell upon the Greene household; but that is because all of the dark secrets of the case were not made known.

Vance was projected into the Benson murder as the result of a direct challenge from Markham; and his activities in the Canary case were due to his own expressed desire to lend a hand. But pure coincidence was responsible for his participation in the Greene investigation. During the two months that had elapsed since his solution of the Canary's death Markham had called upon him several times regarding moot points of criminal detection in connection with the routine work of the District Attorney's office; [redacted] it was during an informal discussion of [redacted] of these problems that the Greene [redacted] [redacted] first mentioned.

Markham and Vance had long been friends. Though dissimilar in tastes and even in ethical outlook, they nevertheless respected each other profoundly. I have often marvelled at the friendship of these two antipodal men; but as the years went by I came more and more to understand it. It was as if they were drawn together by those very qualities which each realized—perhaps with a certain repressed regret—[redacted] lacking in his own nature. [redacted] was forthright, brusque, and, on occasion, domineering, taking life with grim and serious concern, and following the dictates of his legal conscience in the face of every obstacle; honest, incorruptible, and untiring. Vance, on the other hand, was volatile, debonair, and possessed of a perpetual Juvenalian cynicism, smiling ironically at the bitterest realities, and consistently fulfilling [redacted] role of a whimsically disinterested spectator [redacted] life. But, withal, he understood people as profoundly as he understood art, and his dissection of motives and his shrewd readings of character were--as I had many occasions to witness--uncannily accurate. Markham apprehended these qualities in Vance, and sensed their true value.

It was not yet ten o'clock of the morning of November the 9th when Vance and I, after motoring to the old Criminal Courts [redacted]ing on the corner of Franklin and Centre Streets, went directly to the District Attorney's office [redacted] the fourth floor. [redacted] that momentous forenoon two gangsters, each accusing the other of firing the fatal shot in a recent pay-roll hold-up, were to be cross-examined by Markham; and this interview was to decide the question as to which of the men would be charged with murder and which held as a State's witness. Markham and Vance had discussed the situation the night before in the lounge-room of the Stuyvesant Club, and Vance had expressed a desire to be present at the examination. Markham had readily assented, and so we had risen early and driven down-town.

The interview with the two men lasted for an hour, and Vance's disconcerting opinion was that neither was guilty of the actual shooting.

"Y' know, Markham," he drawled, when the sheriff had returned the prisoners to the Tombs, "those two Jack Sheppa[redacted] [redacted] quite sincere: each one [redacted] he's telling [redacted] truth. Ergo, neither of 'em fired [redacted] shot. A distressin' predicament. They're obvious gallows-birds--born for the gibbet; and it's a beastly shame not to be able to round out their destinies in proper fashion. . . . I say, wasn't there another participant in the hold-up?"

Markham nodded. "A third got away. According to these two, it was a well-known gangster named Eddie Maleppo."

"Then Eduardo is your man."

Markham did not reply, and Vance rose lazily and reached for his ulster.

"By the by," he said, slipping into his coat, "I note that our upliftin' press be[redacted] its front pages this morning with head-lines about a pogrom at [redacted] old Greene mansion last night. Wherefore?"

Markham glanced quickly at [redacted] [redacted] on the wall, and frowned.

"That reminds me. Chester Greene called up the first thing this morning and insisted on seeing me. I told him el[redacted] o'clock."

"Where do you fit in?" Vance had taken his hand from the door-knob, and drew out his cigarette-case.

"I don't!" snapped Markham. "But people think the District Attorney's office is a kind of clearing-house for all their troubles. It happens, however, that I've known Chester Greene a long time--we're [redacted] members of the Marylebone Golf Club--and so I must listen to his plaint about what was obviously an attempt to [redacted] the famous Greene plate."

"Burglary--eh, what?" Vance took a [redacted] puffs on his cigarette. "With [redacted] [redacted] shot?"

"Oh, it was a miserable business! An amateur, no doubt. Got in a panic, shot up the place, and bolted."

"Seems a dashed curious proceeding." Vance abstractedly reseated himself in a large armchair near [redacted] door. "Did the antique cutlery actually disappear?"

"Nothing [redacted] taken. The thief [redacted] evidently frightened off before he made his haul."

"Sounds a bit thick, don't y' [redacted].--An amateur thief breaks into a prominent home, casts a predat'ry eye on the [redacted]ning-room silver, takes alarm goes up-stairs and shoots two [redacted] in their respective boudoirs, and then flees. . . . Very touchin' and all that, but unconvincin'. [redacted] came this caressin' theory?"

Markham was glowering, but when he spoke it was with an effort at restraint.

"Feathergill was on duty last night when the call was relayed from Headquarters, and accompanied the police to the house. He agrees with their conclusions."

"Nevertheless, I could bear to know why Chester Greene is desirous of having polite converse with you."

Markham compressed his lips. He was not in cordial mood that morning, and Vance's flippant curiosity irked him. After a moment, however, he said grudgingly:

"Since the attempted robbery interests you so keenly, you may, if you insist, wait and hear what Greene has [redacted] say."

"I'll stay," smiled Vance, removing his coat. "I'm weak; just can't resist a passionate entreaty. . . . Which [redacted] of [redacted] Greenes is Chester? And how is he related to the two deceased?"

"There was only one murder," Markham corrected him in a tone of forbearance. "The oldest daughter--an unmarried woman in her early forties [redacted] killed instantly. A younger daughter, who was also shot, has, I believe, a chance of recovery."

"And Chester?"

"Chester is the elder son, a man of forty or thereabouts. He was the first person on the scene after the shots had been fired."

"What other members of the family are there? I know old Tobias Greene has gone to his Maker."

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"And it was Julia who was killed, eh? Which of the other two girls was shot?"

"The younger--Ada. Her room, it seems is across the hall from Julia's, and the thief apparently got in it by mistake while making his escape. As I understand it, he entered Ada's room immediately after firing on Julia, saw his error, fired again, and then fled, eventually going [redacted] the stairs [redacted] out [redacted] [redacted] entrance."

Vance [redacted] a while in silence.

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"Mr. Chester Greene is here," he announced.

The Greene murder case occurred toward the end of Markham's first year in office. As you may remember, the winter came very early that season. There were two severe blizzards in November, and the amount of snowfall for that month broke all local records for eighteen years. I mention this fact of the early snows because it played a sinister part in the Greene affair: it was, indeed, one of the vital factors of the murderer's scheme. No one has yet understood, or even sensed, the connection between the unseasonable weather of that late fall and the fatal tragedy that fell upon the Greene household; but that is because all of the dark secrets of the case were not made known.

Vance was projected into the Benson murder as the result of a direct challenge from Markham; and his activities in the Canary case were due to his own expressed desire to lend a hand. But pure coincidence was responsible for his participation in the Greene investigation. During the two months that had elapsed since his solution of the Canary's death Markham had called upon him several times regarding moot points of criminal detection in connection with the routine work of the District Attorney's office; and it [redacted] during an informal [redacted]on of one [redacted] these problems that the Greene case was first mentioned.

[redacted] [redacted] [redacted] [redacted] long been friends. Though dissimilar in tastes [redacted] even in ethical outlook, they nevertheless respect[redacted] each other profoundly. I have often marvelled at the friendship [redacted] [redacted] two antipodal [redacted] but as the years [redacted] by I came more and more to understand it. It was as if they were drawn together by those very qualities which each realized--perhaps with a certain repressed regret--were lacking in his own nature. Markham was forthright, brusque, and, on occasion, domineering, taking life with grim and serious concern, and following the dictates of his legal conscience in the face of every obstacle; honest, incorruptible, and untiring. Vance, on the other hand, [redacted] volatile, debonair, and possessed of a perpetual Juvenalian cynicism, smiling ironically at the bitterest realities, [redacted] consistently fulfilling the role of a whimsically disinterested spectator of life. But, withal, he understood people as profoundly as he understood art, and his dissection of motives and his shrewd readings of character were--as I had many occasions to witness--uncannily accurate. Markham apprehended these qualities in Vance, and sensed their true value.

It was not yet ten o'clock of the morning of November the 9th when Vance and I, after motoring to the old Criminal Courts Building on the corner of Franklin and Centre Streets, went directly to the District Attorney's office on the fourth floor. On that momentous forenoon two gangsters, each accusing the other [redacted] firing the fatal shot in a recent pay-roll hold-up, were to be cross-examined by Markham; and this interview was to decide the question as to which of the men would be charged with murder and which held as a State's witness. Markham and Vance had discussed the situation the night before in the lounge-room of the Stuyvesant Club, and Vance had expressed a desire to be present at the examination. Markham had readily assented, and so we had risen early and driven down-town.

The interview with the two men lasted for an hour, and Vance's disconcerting opinion was that neither was guilty of the actual shooting.

"Y' know, Markham," he drawled, when the sheriff had returned the prisoners to the Tombs, "those two Jack Sheppards are quite sincere: each one thinks he's telling the truth. Ergo, neither of 'em fired the shot. A distressin' predicament. They're obvious gallows-birds--born for the gibbet; and it's a beastly shame not to be able to round out their destinies in proper fashion. . . . I say, wasn't there another participant in the hold-up?"

Markham nodded. "A third got away. According to these two, it was a well-known gangster named Eddie Maleppo."

"Then Eduardo is your man."

Markham did not reply, and Vance rose lazily and reached for his ulster.

"By the by," he said, slipping into his coat, "I note that our upliftin' press bedecked its front pages this morning with head-lines about a pogrom at the old Greene mansion last night. Wherefore?"

Markham glanced quickly at the clock on the wall, and frowned.

"That reminds me. Chester Greene called up the first thing this morning and insisted on seeing me. I told him eleven o'clock."

"Where do you fit in?" Vance had taken his hand from the door-knob, and drew out his cigarette-case.

"I don't!" snapped Markham. "But people think the District Attorney's office is a kind of clearing-house for all their troubles. It happens, however, that I've [redacted] Chester Greene a long time--we're both [redacted]s of the Marylebone Golf Club—and so I must listen to his plaint [redacted] what was obviously an attempt to annex the famous Greene plate."

"Burglary--eh, [redacted] Vance took a few puffs on his cigarette. "With two women shot?"

"Oh, it [redacted] a miserable business! An amateur, no doubt. Got in a panic, shot up the place, and bolted."

"Seems a dashed curious proceeding." Vance abstractedly reseated himself in a large armchair near the door. "Did the antique cutlery actually disappear?"

"Nothing was taken. The thief was evidently frightened off before he [redacted] his haul."

"Sounds a bit thick, don't y' know.--An amateur thief breaks into a prominent home, casts a predat'ry eye on the dining room silver, takes alarm goes up-stairs and shoots two women in their respective boudoirs, and then flees. . . . Very touchin' and all that, but unconvincin'. Whence came this caressin' theory?"

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CHAPTER II

[redacted] Investigation Opens

(Tuesday, November 9; 11 A.M.)

When Chester Greene entered it was obvious he was under a nervous strain; but his nervousness evoked no sympathy in me. From the very first I disliked the man. He was of medium height and was bordering on corpulence. There was something soft and flabby in his contours; and, though he was dressed with studied care, there were certain signs of overemphasis about his clothes. His cuffs were too tight; his collar was too snug; and the colored silk handkerchief hung too far out of his breast pocket. He was slightly bald, and the lids of his close-set eyes projected like those of a man with Bright's disease. His mouth, surmounted by a close-cropped blond moustache, was loose; and his chin receded slightly and was deeply creased below the under lip. He typified the pampered idler.

When he had shaken hands with Markham, and Vance and I had been introduced, he seated himself and meticulously inserted a brown Russian cigarette in a long amber-and-gold holder.

"I'd be tremendously obliged, Markham," he said, lighting his cigarette from an ivory pocket-lighter, "if you'd make a personal investigation of [redacted] row that occurred at our diggin's last night. The police will never get anywhere the way they're going about it. Good fellows, you [redacted]-stand--the police. But . . . well, there's something about this affair--don't know just how to put it. Anyway, I don't like it."

Markham studied him closely for several moments.

"Just what's on your mind, Greene?"

The other crushed out his cigarette, though he had taken no more than half a dozen puffs, and drummed indecisively on the arm of his chair.

"Wish I knew. It's a rum affair--damned rum. There's something back of it, too--something that's going to raise the very devil if we don't stop it. Can't explain it. It's a feeling I've got."

"Perhaps Mr. Greene is psychic," commented Vance, with a look of bland innocence.

The man swung about and scrutinized Vance with aggressive condescension. "Tosh!" He brought out another Russian cigarette, and turned again to Markham: "I do wish you'd take a peep at the situation."

Markham hesitated. "Surely you've some reason for disagreeing with the police and appealing to me."

"Funny thing, but I haven't." (It seemed to me Greene's hand shook slightly as he lit his second cigarette.) "I simply [redacted] that my mind rejects [redacted] burglar story automatically."

It was difficult to tell if he were being frank or deliberately hiding [redacted]thing. I did feel, however, that some sort of fear lurked [redacted]th his uneasiness; and I also got the impression that he was far from being heart-broken over the tragedy.

"It seems to me," declared Markham, "that the theory of the burglar is entirely consistent with the facts. There have been many other cases of a house-breaker suddenly taking alarm, losing his head, and needlessly shooting people."

Greene rose abruptly and began pacing up and down.

"I can't argue the case," [redacted] muttered. "It's beyond all that, if you understand me." [redacted] looked quickly at the District Attorney with staring eyes. "Gad! It's got me in a cold sweat."

"It's all too vague and intangible," Markham observed kindly. "I'm inclined to think the tragedy has upset you. Perhaps after a day or two--"

Greene lifted a protesting hand.

"It's no go. I'm telling you, Markham, the police will never find their burglar. I feel it--here." He mincingly laid a manicured hand on his breast.

Vance had been watching him with a faint suggestion of amusement. Now he stretched his legs before him and gazed up at the ceiling.

"I say, Mr. Greene--pardon the intrusion on your esoteric gropings--but do you know of any one with a reason for wanting your two sisters out of the way?"

The man looked blank for a moment.

"No," he answered finally, "can't say that I do. Who, in Heaven's name, would want to kill two harmless women?"

"I haven't the groggiest notion. But, since you repudiate the burglar theory, and since the two ladies were undoubtedly shot, it's inferable that some one sought their demise; and it occurred to me that you, being their brother and domiciled en famille, might know of some one who harbored homicidal sentiments toward them."

Greene bristled, and thrust his head forward. "I know of no one," [redacted] blurted. Then, turning to Markham, he continued wheedlingly: "If I had the slightest suspicion, don't you think I'd come out with it? This thing has got on my nerves. I've [redacted] mulling over it all night, and it's--it's bothersome, frightfully bothersome."

Markham [redacted] non-committally, and rising, walked to the window, where he stood, his hands behind him, gazing down on the gray stone masonry of the Tombs.

Vance, despite his apparent apathy, had been studying Greene closely; and, as Markham turned to the window, he straightened up slightly in his chair.

"Tell me," he began, an ingratiating note in his voice; "just what happened last night? I understand you were the first to reach [redacted] prostrate women."

"I was the first to reach my sister Julia," retorted Greene, with a hint of resentment. "It was Sproot, the butler, [redacted] found Ada unconscious, bleeding from a nasty wound in her back."

"Her back, eh?" Vance leaned forward, and lifted his eyebrows. "She was shot from behind, then?"

"Yes." Greene frowned and inspected his fingernails, as if he too sensed something disturbing in the fact.

"And Miss Julia Greene: was she too shot from behind?"

"No--from the front."

"Extr'ordin'ry!" Vance blew a ring of smoke toward the dusty chandelier. "And had both women retired for the night?"

"An hour before. . . . But what has all that got to do with it?"

"One never knows, does one? However, it's always well to be in possession of these little details when trying to run down the elusive source of a psychic seizure."

"Psychic seizure be damned!" growled Greene truculently. "Can't a man have a feeling about something without--?"

"Quite--quite. But you've asked for the District Attorney's assistance, and I'm sure he would like a few [redacted] before making a decision."

Markham came forward and sat down on the edge of the table. His curiosity had been aroused, and he indicated to Greene his sympathy with Vance's interrogation.

Greene pursed his lips, and returned his cigarette-holder to his pocket.

"Oh, very well. What else do you want to know?"

"You might relate for us," dulcetly resumed Vance, "the exact order of events after you heard the first shot. I presume you did hear the shot."

"Certainly I heard it--couldn't have helped hearing it. Julia's room is next to mine, and I was still awake. I jumped into my slippers and pulled on my dressing gown; then I went out into the hall. It was dark, and I felt my way along the wall until I reached Julia's door. I opened it and looked in--didn't know who might be there waiting to pop me--and I saw her lying in bed, the front of her nightgown covered with blood. There was no one else in the room, and I went to her immediately. Just then I heard another shot which sounded as if it came from Ada's room. I was a bit muzzy by this time--didn't know what I'd better do; and as I stood by Julia's bed [redacted] something of a funk--oh, I was in a funk all right . . ."

"Can't say that I blame you," Vance encouraged him.

Greene nodded. "A damned ticklish position to be in. Well, anyway, as I stood there, I heard some one coming down the stairs from [redacted] servants' quarters on the third floor, and recognized old Sproot's tread. He fumbled along in the dark, [redacted] I heard him enter Ada's door. Then he called to me, and I hurried over. Ada was lying in front of the dressing-table; and Sproot a[redacted] I lifted her on the [redacted]. I'd gone a bit weak in the knees, was expecting any minute to hear another shot--don't know why. Anyway, it didn't come; and then I heard Sproot's voice at the hall telephone calling up Doctor Von Blon."

"I see nothing in your account, Greene, inconsistent with the theory of a burglar," observed Markham. "And furthermore, Feathergill, my assistant, says there were two sets of confused footprints in the snow outside the front door."

Greene shrugged his shoulders, but did not answer.

"By the by, Mr. Greene,"--Vance had slipped down in his chair and was staring into space--"you said that when you looked into Miss Julia's room you saw her in bed. How was that? Did you turn on the light?"

"Why, no!" The man appeared puzzled by the question. "The light was on."

There was a flutter of interest in Vance's eyes.

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"I haven't the groggiest notion. But, since you repudiate the burglar theory, and since the two ladies were undoubtedly shot, it's inferable that some one sought their demise; and it occurred to me that you, being their brother and domiciled en famille, might know of some one who harbored homicidal sentiments toward them."

Greene bristled, and thrust his head forward. "I know of no one," he blurted. Then, turning to [redacted] he continued wheedlingly: "If I had the slightest suspicion, don't [redacted] think I'd come [redacted] with it? This thing has got on my [redacted] I've [redacted] mulling over it all night, [redacted] it's--it's bothersome, frightfully bothersome."

Markham nodded non-committally, and rising, walked to the window, where [redacted] stood, his hands [redacted] him, gazing down on the gray stone masonry of the Tombs.

Vance, despite his apparent apathy, had been studying Greene closely; and, as Ma[redacted]ham turned to the window, he straightened up slightly in [redacted] chair.

"Tell me," he began, an ingratiating note in his voice; "just [redacted] happened last night? I understand [redacted] [redacted] the first to reach the prostrate women."

"I was the first to reach my sister Julia," retorted Greene, with a hint of resentment. "It was Sproot, the butler, who found Ada unconscious, bleeding from a nasty wound in her back."

"Her back, eh?" Vance leaned forward, and lifted his eyebrows. "She was shot from [redacted], then?"

"Yes." [redacted] frowned and inspected [redacted] fingernails, as if he too sensed something disturbing in [redacted] fact.

"And Miss Julia Greene: was she too shot from behind?"

"No--from the front."

"Extr'ordin'ry!" Vance blew a ring of smoke toward the dusty chandelier. "[redacted] had both women retired for [redacted] night?"

"An hour before. . . . But what [redacted] all that got to do with it?"

"One never knows, does one? [redacted], it's always well [redacted] be in possession of these little details [redacted] trying [redacted] [redacted] down the elusive source of a psychic seizure."

"Psychic seizure be [redacted]" growled Greene truculently. "Can't a man have a feeling about something without--?"

"Quite--quite. But you've asked for the District Attorney's assistance, and I'm sure he would like a few data before making a decision."

Markham came forward and sat down on the edge of the table. His curiosity had been aroused, and he indicated to Greene his sympathy with Vance's interrogation.

Greene pursed his lips, and returned his cigarette-holder to his pocket.

"Oh, very well. What else do you want to know?"

"You might relate for us," dulcetly resumed Vance, "the exact order of events after you heard the first shot. I presume you did hear the shot."

"Certainly I heard it--couldn't have helped hearing it. Julia's room is next to mine, and I was still awake. I jumped into my slippers and pulled on my dressing gown; then I went out into the hall. It was dark, and I felt my way along the wall until I reached Julia's door. I opened it and looked in--didn't know who might be there waiting to pop me--and I saw her lying in bed, the front of her nightgown covered with blood. There was no one else in the room, and I went to her immediately. Just then I heard another shot which sounded as if it came from Ada's room. I was a bit muzzy by this time--didn't know what I'd better do; and as I stood by Julia's bed in something of a funk--oh, I was in a funk all right . . ."

"Can't say that I blame you," Vance encouraged him.

Greene nodded. "A damned ticklish position to be in. Well, anyway, as I stood there, I heard some one coming down the stairs [redacted] the servants' quarters on the [redacted] floor, and recognized [redacted] Sproot's tread. He fumbled along in the dark, [redacted] I heard him enter Ada's door. Then he called to me, and I hurried over. Ada was lying in front of the dressing-table; and Sproot and I lifted her on the bed. I'd gone a bit weak in the knees, was expecting any minute to hear another shot--don't know why. Anyway, it didn't come; and then I heard Sproot's voice at the hall telephone calling up Doctor Von Blon."

"I see nothing in your account, Greene, inconsistent with the theory of a burglar," observed Markham. "And furthermore, Feathergill, [redacted] assistant, says there were two sets [redacted] confused footprints in the snow outside [redacted] front door."

Greene shrugged his shoulders, but did not answer.

"By the by, Mr. Greene,"--Vance had slipped down in his chair and was staring into space--"you said that when you looked into Miss Julia's room you saw her in bed. How was that? Did you turn on the light?"

"Why, no!" The man appeared puzzled by the question. "The light was on."

There was a flutter of interest in Vance's eyes.

[redacted] II

The Investigation Opens

(Tuesday, November 9; 11 A.M.)

When Chester Greene entered it [redacted] obvious he was under a nervous strain; but his nervousness evoked no sympathy in me. From the very first I disliked the [redacted] He was of medium height [redacted] was bordering on corpulence. There was something soft and flabby in his contours; and, though he [redacted] dressed with studied care, there were [redacted] signs [redacted] overemphasis about his clothes. His cuffs were too tight; his collar [redacted] too snug; and the colored silk handkerchief hung too far out of his breast pocket. He was slightly bald, and the lids of his close-set eyes projected like those of a man with Bright's disease. His mouth, surmounted by a close-cropped blond moustache, was loose; and his chin receded slightly and was deeply creased below the under lip. He typified the pampered idler.

When he had shaken hands with Markham, and Vance and I had been introduced, he seated himself and meticulously inserted a brown Russian cigarette in a long amber-and-gold holder.

"I'd be tremendously obliged, Markham," [redacted] said, lighting his cigarette from an ivory pocket-lighter, "if you'd make a personal investigation of the row that occurred at our diggin's last night. The police will never get anywhere the way they're going [redacted] it. Good fellows, you understand--the police. But . . . well, there's something about this affair--don't know just how to put it. Anyway, I don't like it."

Markham [redacted] him closely for several moments.

"Just what's on your mind, Greene?"

The other crushed out his cigarette, though [redacted] [redacted] taken [redacted] [redacted] than half a dozen puffs, [redacted] [redacted] indecisively on [redacted] arm of his chair.

"Wish I knew. It's a rum affair--damned rum. There's something back of it, too--something that's going [redacted] raise [redacted] very devil if we don't stop it. Can't explain it. It's a feeling I've got."

"Perhaps Mr. Greene is psychic," commented Vance, with a look of bland innocence.

The man swung about and scrutinized Vance with aggressive condescension. "Tosh!" He brought out another Russian cigarette, and turned again to Markham: "I do wish you'd take a peep at the situation."

Markham hesitated. "Surely you've some reason for disagreeing with the police and appealing to me."

"Funny thing, but I haven't." (It seemed to me Greene's hand shook slightly as he lit his second cigarette.) "I simply know that my mind rejects the burglar story automatically."

It was difficult to tell if he were being frank or deliberately hiding something. I did feel, however, that some sort of fear lurked beneath his uneasiness; and I also got the impression that he was far from being heart-broken over the tragedy.

"It seems to me," declared Markham, "that the theory of the burglar is entirely consistent with the facts. There have been many other cases of a house-[redacted] suddenly taking alarm, losing his head, [redacted] needlessly shooting people."

Greene rose abruptly and began pacing [redacted] [redacted] down.

"I can't argue the case," he muttered. "It's beyond all that, if you understand [redacted]" He looked quickly at the District Attorney with staring eyes. "Gad! It's got me in a cold sweat."

"It's all too vague and intangible," Markham observed kindly. "I'm inclined to think the tragedy has upset you. Perhaps after a day or two--"

Greene lifted a protesting hand.

"It's no go. I'm telling you, Markham, [redacted] police will [redacted]r find their burglar. I feel it--here." He mincingly laid a manicured hand on his breast.

[redacted] [redacted] been watching him with a faint suggestion of amusement. Now he stretched his legs before him and gazed up at the ceiling.

"I say, Mr. Greene--pardon the intrusion on your esoteric gropings--but do you know of any one with a reason for wanting your two sisters out of the way?"

The man looked blank for a moment.

"No," he answered finally; "can't say that I do. Who, in Heaven's name, would want to kill two harmless women?"

"I haven't the groggiest notion. But, since you repudiate the burglar theory, and since the two ladies were undoubtedly shot, it's inferable that some one sought their demise; and it occurred to me that you, being their brother and domiciled en famille, might know of some one who harbored homicidal sentiments toward them."

Greene bristled, and thrust his head forward. "I know of no one," he blurted. Then, turning to Markham, he continued wheedlingly: "If I had the slightest suspicion, don't you think I'd come out with it? This thing has got on my nerves. I've been mulling over it all night, and it's--it's bothersome, frightfully bothersome."

[redacted] [redacted] non-committally, and rising, walked to [redacted] window, where he stood, his [redacted] behind him, gazing down on [redacted] gray stone masonry of the Tombs.

Vance, despite his apparent apathy, had [redacted] studying Greene closely; and, as [redacted] turned to the window, [redacted] straightened up slightly in his chair.

"Tell me," he began, an ingratiating note in his voice; "just what happened last night? I understand you were the first to reach the prostrate women."

"I was the first to reach my sister Julia," retorted Greene, with a hint of resentment. "It was Sproot, the butler, who found Ada unconscious, bleeding from a nasty wound in her back."

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"An hour before. . . . But what has all that got to do with it?"

"One never knows, does one? However, it's always [redacted] [redacted] [redacted] in possession of these little details when trying to run down the elusive source of a psychic seizure."

"Psychic seizure be damned!" growled Greene truculently. "Can't a man have a feeling about something without--?"

"Quite--quite. But you've asked for the District Attorney's assistance, [redacted] I'm sure he would like a few data before asking a decision."

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"Oh, very well. [redacted]t else do you [redacted] to know?"

"You might relate for us," dulcetly resumed Vance, "the exact order of events after you heard the first shot. I presume you did hear the shot."

"Certainly I heard it--couldn't have helped hearing it. Julia's room is next to mine, and I was still awake. I jumped into my slippers and pulled on my dressing gown; then I went out [redacted] [redacted] hall. It was dark, and I felt my way along the wall until I reached Julia's door. I opened it and looked in--didn't know who might be there waiting to pop me--and I saw her lying in bed, the front of her nightgown covered with blood. There was no one else in the room, and I went to her immediately. Just then I heard another shot which sounded as if it came from Ada's room. I was a bit muzzy by this time--didn't know what I'd better do; and as I stood by Julia's bed in something of a funk--oh, I was in a funk all right . . ."

"Can't say that I blame you," Vance encouraged him.

Greene nodded. "A damned ticklish position to be in. Well, anyway, as I stood there, I heard some one coming down the stairs from the servants' quarters on [redacted] third floor, and recognized old Sproot's tread. He fumbled along in the dark, and I heard him enter Ada's door. Then he called [redacted] me, and I hurried over. Ada was lying in front of the dressing-table; and Sproot and I lifted her on the bed. I'd gone a bit weak [redacted] [redacted] knees, was expecting any minute to hear another shot--don't know why. Anyway, it didn't come; and then I heard Sproot's voice at the hall telephone calling up Doctor Von Blon."

"I see nothing [redacted] your account, Greene, inconsistent with the theory of a burglar," observed Markham. "And furthermore, Feathergill, my assistant, says there were two sets of confused footprints in the snow outside the front door."

Greene shrugged his shoulders, but did not answer.

"By the by, Mr. Greene,"--Vance had slipped [redacted] in his chair and was staring into space--"you said that when you looked into Miss Julia's room you saw her in bed. How was that? Did you turn on the light?"

"Why, no!" The man appeared puzzled by the question. "The light was on."

There was a flutter of interest in Vance's eyes.

"And how about Miss Ada's room? Was the light on there also?"

"Yes."

Vance reached into his pocket, and, drawing [redacted] his cigarette-case, carefully and deliberately selected a cigarette. I recognised in the action [redacted] evidence of repressed inner excitement.

"So the lights were on in both rooms. Most interestin'."

Markham, too, recognised the eagerness beneath his apparent indifference, and regarded him expectantly.

"And," pursued Vance, after lighting his cigarette leisurely, "how long a time would you say elapsed between the two shots?"

Greene was obviously annoyed by this cross-examination, but he answered readily.

"Two or three minutes--certainly no longer."

"Still," ruminated Vance, "after [redacted] heard the first shot you [redacted]e from your bed, donned slippers and robe, [redacted] into the hall, felt along the wall to [redacted] next [redacted], opened the door cautiously, peered inside, and then crossed the [redacted] to the bed--all this, I gather, before the second shot [redacted] fired. Is that correct?"

"Certainly it's correct."

"Well, well! As you say, two or three minutes. Yes, at least that. Astonishin'!" Vance turned [redacted] [redacted] "Really, y' know, old man, I don't wish [redacted] influence your judgment, but I rather [redacted] you ought to accede to Mr. Greene's request to take a hand [redacted] this investigation. I too have a psychic feeling about the case. Something tells me that your eccentric burglar will prove an ignis fatuus."

Markham eyed him with meditative curiosity. Not only had Vance's questioning of Greene interested him keenly, but he knew, as a result of long experience, that Vance would not have made the suggestion had he not [redacted] a good reason for doi[redacted] so. I was in no wise surprised, therefore, when [redacted] [redacted] [redacted] his restive visitor and said:

"Very well, Greene, I'll see what I can do in the matter. I'll probably be at your house early this afternoon. Please see that every one is present, as I'll want to question them."

Greene held out a trembling hand. "The domestic roster—family and servants--will be complete when you arrive."

[redacted] strode pompously from the room.

Vance sighed. "Not a nice creature, Markham--not at all a nice creature. I shall [redacted] be a politician if it involves an acquaintance with such gentlemen."

Markham seated himself at his de[redacted] with a disgruntled air.

"Greene is highly regarded as a social--not a political--decoration," he said maliciously. "He belongs to your totem, not mine."

"Fancy that!" Vance stretched himself luxuriously. "Still, it's you who fascinate him. Intuition tells me he is not overfond of me."

"You did treat him a bit cavalierly. Sarcasm is not exactly a [redacted] of endearment."

"But, Markham old thing, I wasn't pining for Chester's affection."

"You think he knows, or suspects, [redacted] thing?"

Vance gazed through the long window into the bleak sky beyond.

"I wonder," he murmured. Then: "Is Chester, by any chance, a typical representative of the Greene family? Of recent years I've done so little mingling with the elite that I'm woefully ignorant of the East Side nabobs."

Markham nodded reflectively.

"I'm afraid he is. The original Greene stock was sturdy, but the present generation seems to have gone somewhat to pot. Old Tobias the Third--Chester's father--was a rugged and, in many ways, admirable character. He appears, however, to have been the last heir of the ancient [redacted] qualities. What's left of the family has suffered some sort of disintegration. They're not exactly soft, but tainted with patches of incipient decay, like fruit that's lain [redacted] the ground too long. [redacted] [redacted] money and leisure, I imagine, and too little restraint. On the other hand, [redacted]'s a certain intellectuality lurking in the [redacted] Greenes. They all seem to have good minds, even if futile and misdirected. In fact, I think you underestimate Chester. For all his banalities and effeminate mannerisms, he's far from being as stupid as you regard him."

"I regard Chester [redacted] stupid! My dear Markham! You wrong [redacted] abominably. No, [redacted]. There's nothing of the [redacted] ass about our Chester. He's shrewder even than you think him. Those oedematous eyelids veil a pair of particularly crafty eyes. Indeed, it was largely his studied pose of fatuousness that led [redacted] to suggest that you aid and abet in the investigation."

Markham leaned back and narrowed his eyes.

"What's in your [redacted], Vance?"

"I told you. A psychic seizure--same like Chester's subliminal visitation."

Markham knew, by this elusive answer, that for the moment Vance had no intention of being more definite; and after a moment of scowling silence he turned to the telephone.

"If I'm to take on this case, I'd better find out who has charge of it and get what preliminary information I can."

He called up Inspector Moran, the commanding officer of the Detective Bureau. After a brief conversation he [redacted] to Vance with a smile.

"Your friend, Sergeant Heath, has the case [redacted] hand. He happened to be in the office just now, and is coming here immediately."

In less than fifteen minutes Heath arrived. Despite the fact that he had been up most of the night, he appeared unusually alert and energetic. His broad, pugnacious features were as imperturbable as ever, and his pale-blue eyes held their habitual penetrating intentness. [redacted] greeted [redacted] with an elaborate, though perfunctory, handshake; [redacted] then, seeing Vance, relaxed his features into a good-natured smile.

"Well, if it isn't Mr. Vance! What have you been up to, sir?"

Vance rose and shook hands with him.

"Alas, Sergeant, I've been immersed in the terracotta ornamentation of Renaissance facades, and other such trivialities, since I saw you last. But I'm happy to note that crime is picking up again. It's a deuced dra[illegible]rld without a nice murky murder now a[illegible]hen, don't y' know."

Heath cocked an eye, and turned inquiringly to the District Attorney. He had long since learned how to read between the lines of Vance's badinage.

"It's this Greene [redacted]e, Sergeant," said Markham.

"I thought so." Heath sat down heavily, and inserted a black cigar between his lips. "But nothing's broken yet. We're rounding up all the regulars, and looking into their alibis for last night. But it'll take several days before the check-up's complete. If the bird who did the job hadn't got scared before he grabbed the swag, we might be able to trace him through the pawnshops and fences. But something rattled him, or he wouldn't have shot up the works the way he did. And that's what makes me think he may be a new one at the racket. If he is, it'll make our job harder." He held a match in cupped hands to his cigar, and puffed furiously. "What did you want to know about the prowl, sir?"

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"Chester Greene was here," he explained presently; "and he seems convinced that the shooting was not the work of a thief. He asked me, as a special favor, to look into the matter."

Heath gave a derisive grunt.

"Who but a burglar in a panic would shoot down two women?"

"Quite so, Sergeant." It was Vance who answered. "Still, the lights were turned on in both rooms, though the women had gone to bed an hour before; and there was an interval of several minutes between the two shots."

"I know all that." Heath spoke impatiently. "But if an amachoor did the job, we can't tell exactly what did happen upstairs there last night. When a bird loses his head--"

"Ah! There's the rub. When a thief loses his head, d'ye see, he isn't apt to go from room to room turning on the lights, even assuming he knows where and how to turn them on. And he certainly isn't going [redacted] dally around for several minutes in a black hall between such fantastic operations, especially after he has shot some one and alarmed [redacted] house, what? It doesn't look like panic to me; it looks strangely like design. Moreover, why should this precious amateur of yours be cavorting about the boudoirs up-stairs when the loot was in the dining-room below?"

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"And [redacted] [redacted] Miss Ada's [redacted] [redacted] the light on there also?"

"Yes."

Vance [redacted] [redacted] his pocket, and, drawing out his cigarette-case, carefully and deliberately selected a cigarette. I recognized in the action an evidence of repressed inner excitement.

"So the lights were on in both rooms. Most interestin'."

Markham, too, recognized the eagerness beneath his apparent indifference, and regarded him expectantly.

"And," pur[redacted] Vance, af[redacted] lighting his cigarette leisurely, "how long a time would [redacted] [redacted] elapsed between [redacted] two shots?"

Greene was obviously annoyed by [redacted] cross-examination, but he answered readily.

"Two or three minutes--certainly no longer."

"Still," [redacted] Vance, "after you heard the first shot you rose from your bed, donned slippers [redacted] robe, [redacted] into the hall, felt along [redacted] wall to the next room, opened the door cautiously, peered inside, and then crossed the room to the bed--all this, I gather, before the second shot was fired. Is that correct?"

"Certainly it's correct."

"Well, well! As you say, two or three minutes. Yes, at least that. Astonishin'!" Vance turned to Markham. "Really, y' know, old man, I don't wish to influence your judgment, but I rather think you ought to accede [redacted] Mr. Greene's request [redacted] take a [redacted] in this investigation. I too have a psychic feeling about the case. Something tells me that your eccentric burglar will prove an ignis fatuus."

[redacted] eyed him with meditative curiosity. Not only [redacted] Vance's questioning of Greene interested him keenly, but he knew, as a result of long experience, that Vance would not have made the suggestion had he not had a good reason for doing so. I was in no wise surprised, therefore, when he [redacted]rned to his restive visitor and said:

"Very well, Greene, I'll see what I can [redacted] in the matter. I'll probably be at your [redacted] early this afternoon. Please see that every [redacted] is present, as I'll want [redacted] question them."

[redacted] [redacted] out a trembling hand. "The domestic roster--family and servants--will be complete when you arrive."

He strode pompously from the room.

Vance sighed. "Not a nice creature, Markham -not at all a nice creature. I shall never be a politician if [redacted] involves an acquaintance wi[redacted] such gentlemen."

Markham seated himself at his desk with a disgruntled air.

"Greene is highly regarded as a social--not a political--decoration," [redacted] said maliciously. "He belongs [redacted] your totem, not mine."

"Fancy that!" Vance stretched himself luxuriously. "Still, it's you who fascinate him. Intuition tells me he is not overfond of me."

"You did treat him a bit cavalierly. Sarcasm is not exactly a means of endearment."

"But, Markham old thing, I wasn't pi[redacted]ng for Chester's affection."

"You think he knows, or suspects, s[redacted] thing?"

Vance gazed through the l[redacted] window into the bleak sky beyond.

"I wonder," he murmured. Then: "Is Chester, by any chance, a typical representative of the Greene family? Of recent years I've [redacted] [redacted] little mingling with the elite that I'm woefully ignorant of the East Side nabobs."

Markham nodded reflectively.

"I'm afraid he is. The original Greene stock was sturdy, but the present generation seems to have gone somewhat to pot. Old Tobias the Third--Chester's father—was a rugged and, in many ways, admirable character. He appears, however, to have been the last heir of the ancient Greene qualities. What's left of the family has suffered [redacted] sort of disintegration. They're not exactly soft, but tainted with patches of incipient decay, like fruit that's lain on the ground too long. Too much money [redacted] leisure, I imagine, and too little restraint. On the other hand, there's a certain intellectuality lurking in the new Greenes. [redacted]y all seem to have good minds, even if futile [redacted] misdirected. In fact, I think you underestimate Chester. [redacted] all his banalities [redacted] effeminate mannerisms, he's far from being as stupid as you regard him."

"I regard Chester as stupid! My dear Markham! You wrong [redacted] abominably. No, no. There's nothing of the anointed ass about our Chester. He's shrewder even than you think him. Those oedematous eyelids veil a pair of particularly crafty eyes. Indeed, it was largely his studied [redacted] [redacted] fatuousness that led [redacted] to suggest [redacted] you aid and [redacted] in the investigation."

[redacted] leaned [redacted] and narrowed his eyes.

"What's in your mind, Vance?"

"I told you. A psychic seizure--same like Chester's subliminal visitation."

[redacted] knew, by this elusive answer, that [redacted]r the moment Vance had no intention [redacted] being more definite; and after a moment of scowling silence he turned [redacted] the telephone.

"If I'm to [redacted] on this case, I'd better [redacted] out who has charge of it and get what preliminary information I can."

He [redacted] up Inspector Moran, the [redacted]manding officer of the Detective Bureau. After a brief conversation he turned [redacted] Vance with a smile.

"Your friend, Sergeant Heath, has the case in h[redacted]. He happened to [redacted] in the office just now, and is coming here immediately."

[redacted] less than fifteen minutes [redacted] arrived. Despite the fact that [redacted] [redacted] been up most of the night, [redacted] appeared unusually alert and energetic. His broad, pugnacious features were as imperturbable as ever, and his pale-blue eyes held their habitual penetrating intentness. He greeted Markham with an elaborate, though perfunctory, handshake; and then, seeing Vance, relaxed his features into a good-natured smile.

"Well, if it isn't Mr. Vance! What have you been up to, sir?"

Vance rose and shook hands with him.

"Alas, Sergeant, I've been immersed in the terracotta ornamentation of Renaissance facades, and other such trivialities, since I saw you last. [redacted] I'm happy to note that crime is picking up again. It's a deuced drab world without a nice murky murder now and then, don't y' know."

Heath cocked an eye, and turned inquiringly to the District Attorney. He had long since learned how to read between the lines of Vance's badinage.

"It's this Greene case, Sergeant," said Markham.

"I thought so." Heath sat down heavily, [redacted] inserted a black cigar between his lips. "[redacted] nothing's broken yet. We're rounding up all the regulars, and looking into their alibis for last night. But it'll take several days before the check-up's complete. If the bird who did the job hadn't got scared before he grabbed the swag, we might be able to trace him through the pawnshops and fences. But something rattled him, or he wouldn't have shot up the works the way he did. And that's what makes me think he may be a new one at the racket. If he is, it'll make our job harder." [redacted] held a match in cupped hands to his cigar, and puffed furiously. "What did you want to know about [redacted] prowl, sir?"

Markham hesitated. The Sergeant's matter-of-fact assumption that a [redacted] burglar was the culprit disconcerted him.

"Chester Greene was here," he explained presently; "and he [redacted] convinced that the shooting was not the work of a thief. He asked me, [redacted] a special favor, to look into the matter."

Heath gave a derisive grunt.

"Who but a burglar in a panic would shoot down two women?"

"Quite so, Sergeant." It was Vance who answered. "Still, the lights were turned on in both rooms, though the women had gone to bed an hour before; and there was an interval of several minutes between the two shots."

"I know all that." Heath spoke impatiently. "But if an amachoor did the job, we can't tell exactly what did happen upstairs there last night. When a bird loses his head--"

"Ah! There's the rub. When a thief loses his head, d'ye see, he isn't apt to go from room to room turning on the lights, even assuming he knows where and how to turn them on. And he certainly isn't going to dally around for several minutes in a black hall between such fantastic operations, especially after [redacted] has shot some one and alarmed the house, what? It doesn't look like panic to me; it looks strangely like design. Moreover, why should this precious amateur of yours be cavorting about the boudoirs up-stairs when the loot was in the dining-room below?"

"We'll learn all about that when we've got our man," countered Heath doggedly.

"The point is, Sergeant," put in Markham, "I've given Mr. Greene my promise [redacted] look into the matter, and I wanted to get what details I could from you."

Education. A sample page of his work is shown. On one side of a page, an abstract of the thesis appears in pica typescript reduced to about 60% of full size; on the other side of the page a longer abstract of the thesis is reproduced in a reduction of 90%-95% of normal size. The cost of publishing theses in this format has proven to be very low. Three volumes of abstract theses, filling 854 typescript pages, and containing 300,000 words were published at a cost of $300.00. The cost of reproducing in reduced size 600 copies of an eighty-page set of abstracts was $107.00 in 1933. Two hundred and fifty copies were bound by the Spiral Binding Company for $.05 per copy, making a total cost of $120.00. In 1934, the cost of 700 copies was $127.00.

For reading the miniature print, Dr. Peters found after experimentation that a stereoscope, with the lenses reversed and with an adapted slide, was most convenient for prolonged reading. Dr. Peters sells this adapted stereoscope for approximately $3.00. He also recommends an electric illuminated reading glass device, magnifying from two to four diameters and selling for about $7.50. A third reading apparatus which he suggests is the Clerevu Table Magnifier, with a 6" lens on an adjustable stand. This device, magnifying two to four diameters, sells for $12.00.

Besides the abstracts, some of the doctoral dissertations of the department have been published in substantially the same manner. But in the case of doctoral dissertations, a nine- or ten-page abstract at the 40% reduction is given first, and then the whole dissertation follows in miniatured pages at the 90% reduction. These dissertations include about 100 pages of typewritten material each and average about 35,000 words per thesis. The cost of dissertations published in this manner is $50.00 for 500 copies, including assembling and binding, but not including cost of preparing the manuscript.

Fiske Method

Reference has already been made to the publication of the Covarrubias Tesoro de la Lengua Castellana o Espanola in reduced size for reading with a magnifying lens. This publication was related to the development sponsored by Admiral Bradley A. Fiske, who has developed a hand reading lens equipment that develops higher magnifications than those available with an ordinary reading glass. In its most recent form, the Fiskoscope is a small binocular lens equipment set in a frame which can be held to the eye like a lorgnette. The frame holds a long strip of paper which can be moved up or down by rotating a ratchet. The text is typewritten with short lines so that about 150 words of typescript are laid on a page, double spaced. This page is then reduced seven diameters. The field of vision of the Fiskoscope covers this small page; there is, therefore, no difficulty about skimming. But the difficulties of skimming might be expected to appear if book pages containing 450 words should be copied; and a number of persons who have tried reading with the device complain that it fatigues their eyes. This may be the result of habit, for microscope workers train themselves to use without fatigue lenses of higher magnifying power. A reproduction of a strip of Fiskoscope reading matter (Figure LVII) and a picture of a Fiskoscope (Figure LVI) are printed herewith.

The price of reproductions suited to this apparatus is certainly attractive. In the American Printer of January, 1932, there is an article stating that Fiske books of 100,000 words can be printed on two strips of paper at a cost of $.05. Each strip of paper is 2 5/8" wide and 23 1/2" long, including margins. The typescript is reduced to 1/25 of original size, and is printed on both sides of the strip of paper. Admiral Fiske secured a quotation of $557.00 for an edition of 10,000 books of 100,000 words, printed on a good quality paper.

Filmstat Reproduction

The New York Times, Peters, and Fiskoscope enterprises have all involved a use of the reduced copy methods as an alternative to publication. A different class of use is suggested by the experiments of Mr. Atherton Seidell of the U. S. Public Health Service, by Dr. L. Bendikson of the Huntington Library at San Marino, and by the developments under way in the Folmer Graflex Corporation of Rochester, New York.

Mr. Atherton Seidell, who has been active in promoting what he calls "filmstat" reproduction, counts on reducing book pages about ten diameters and reading them by several methods. A special magnifier, to be manufactured by the Spencer Lens Company, will be sold for $5.00 including the handle and an eye shade for the eye not used. A picture of it is shown. The stand that can be used with the device will sell for about $3.00. This system will give about eight diameters of magnification. An alternative projector device, to cost about $50.00, suitable for reading filmstats, will be described in a later chapter on projection apparatus.

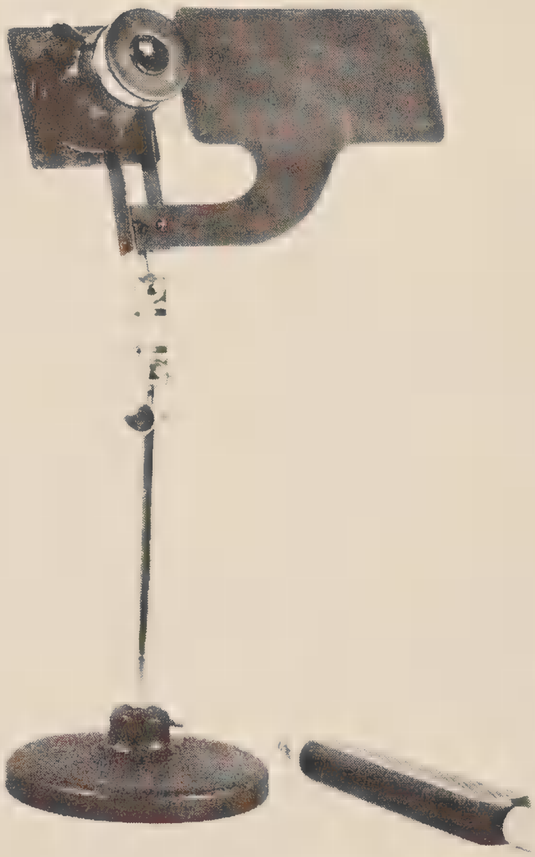


FIGURE LVIII

Spencer Magnifier

Bendikson Procedure

Dr. Bendikson uses a Leica camera to take photographs of pages on the ordinary moving picture film, with exposures about 1" x 1 1/4". Then he lays down a few rows of these film copies side by side in a printing frame and makes from them a positive copy on paper, exactly as if he were making a print from any negative. A reproduction of one of Dr. Bendikson's prints is included herewith.

For reading these prints, he uses a low-power binocular microscope. This microscope is manufactured by E. Leitz, Inc. (code word, BSM-B). The image produced by this apparatus is a true one, not inverted or reversed. Dr. Bendikson uses three different pairs of oculars with this microscope: a-5, with an enlargement power of 3.5, a-10, with magnification of 7; and a-15, which can enlarge 10.5. The a-10 oculars, which Dr. Bendikson generally uses, with a magnifying power of seven diameters, will bring back to normal size a page of an ordinary octavo book that has been reduced to the width of the moving picture film.

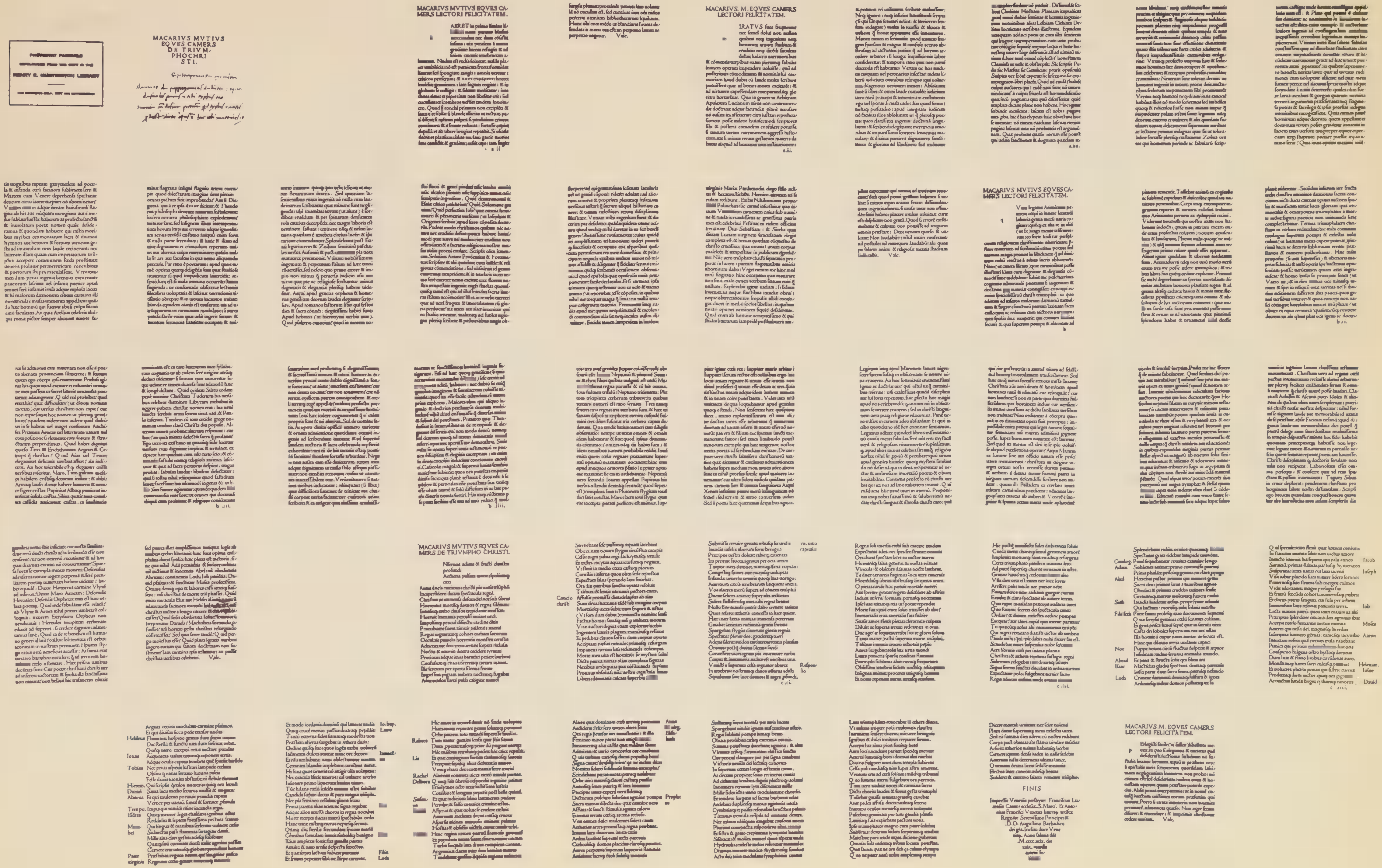
The writer has no experience with the optical system used by Dr. Bendikson, and cannot estimate how it compares from the standpoint of eyestrain with the Fiskoscope. It must be noted that any and all pages reproduced by this method are reduced to the same width, namely, one inch, the width of the available surface of the moving picture strip.

Van Iterson Device

Professor G. van Iterson, of the Technical University at Delft, Holland, has invented a reading device for microprints. A picture of it is shown herewith (Figure LXI).

MACARIUS MUTIUS - DE TRIUMPHO CHRISTI - 1494

D.B.



MACARIVS MVTIVS
EQVES CAMERS
DE TRIVM
PHOCHRI
STI.

FIGURE LIX

Bendikson's Microprints

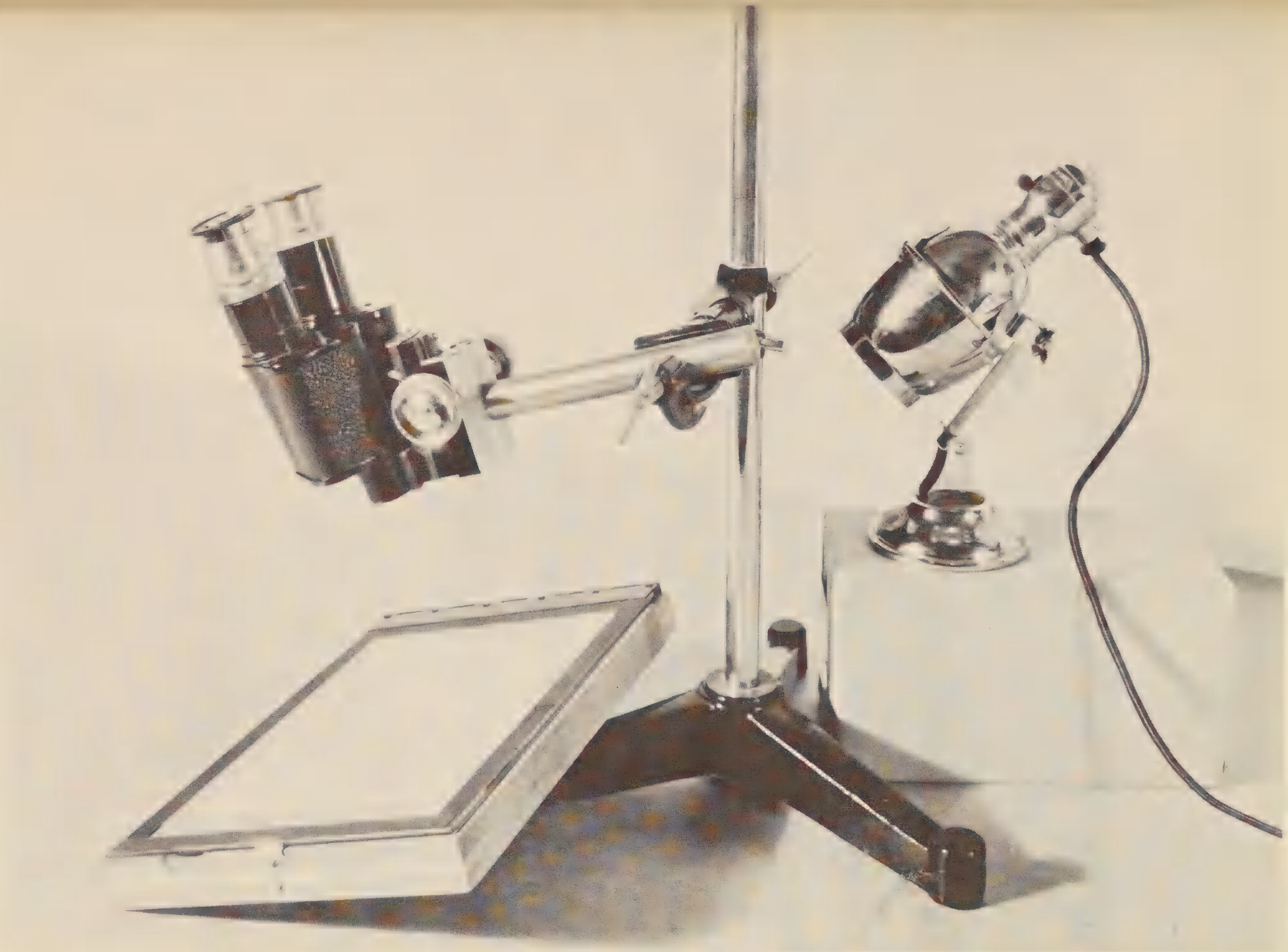


FIGURE LX

Bendikson's Microscope

The apparatus was designed primarily for use with 5" x 7" micro-prints, each print containing eighteen pages of letterpress material. Dr. Bendikson, who went into the question of film copying with Professor van Iterson when the latter was in California several years ago, has very kindly given the writer an explanatory description of the device. Attached to a desklike structure is a bracket, which holds a ring illuminator with five small lamps that surround a plano-convex lens. On top of this drum-shaped illuminator is a second magnifier. The micro-print is slipped in a pressure frame, which slides under the illuminator-magnifier.

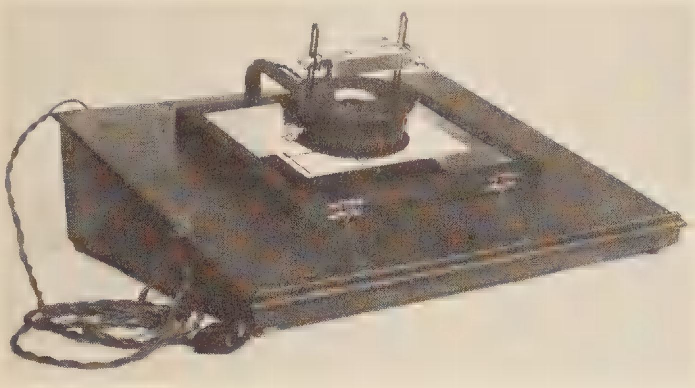


FIGURE LXI

Van Iterson's device

Folmer Graflex Recording Camera

The Folmer Graflex Corporation has developed a recording camera that is used to take photographs of meter readings on a strip of paper. It is now adapting this camera to the general work of record copying. The width of the photographic strip in this camera is 2 1/4". That is to say, it would reduce an 8" sheet of typescript a little less than four diameters, and copy a column of newsprint full size. Obviously, the miniature copies made with this camera will fall in that zone where naked eye reading is beginning to be difficult and reading glass reading is still easy. If the camera is developed, as it will probably be, to take a long roll of paper, the cost of photographic materials per page copied will be somewhere in the neighborhood of one-third to one-half cent a page. This Graflex copying camera, taking pictures directly on paper, will probably offer the individual scholar one of the most convenient devices for note taking. Since paper costs less than film, the scholar can have a much larger copy of his pages for a slightly larger material cost, and this increase in size may be just sufficient to render the copy legible with the naked eye, or with an ordinary cheap reading glass. It is to be hoped that equipment of this kind may become available to American scholars at a price not greatly in excess of the price of typewriting equipment.

Another principle that could be used in copying for reading through magnifying glass systems is the principle of the multiple exposure machine. If the Folmer Graflex multiple exposure camera were adapted for document copying, it would permit the division of a 5" x 7" sheet of paper of film into any number of subdivisions, giving the user the chance to find that degree of reduction that best suits him from the standpoint of economy of materials on the one hand and prevention of eyestrain on the other.

If a new positive photocopying paper appears, as was suggested in the preceding chapters, it would be useful in the preparation of these reduced-size copies on paper. Reduced-size copying on photostat paper is always a possible alternative to reduced-size copying on film. To the extent that the use of a film copy negative introduces labor-saving features in the making of paper copies, the effect is to bring the costs of paper copies nearer to the bare cost of materials, and hence to emphasize and increase the economies that will result for high reduction ratios on paper. For the more the factor of material costs predominates, the greater is the cost advantage in carrying reductions to the furthest practical extreme.

Tru-Vue Apparatus

Reduced scale photography can handle pictures as well as texts. The fact that a picture must be seen as a whole makes it necessary that the field of view of any optical system used for viewing reduced-size pictures should be large, and this is the sticking point in the development of viewing apparatus that enlarges more than two or three diameters.

A special apparatus, related to the old-style stereopticon, has been placed on the market under the trade name Tru-Vue.[2] It is a small binocular viewing apparatus, which receives a 35 mm. roll of film. The Tru-Vue shows "pictures with depth." The pictures viewed are printed double on the film, thus yielding the regular stereoptican illusion of depth. The Tru-Vue pictures are, perhaps, suitable substitutes for picture post cards. The magnifier sells for $1.00.

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2. Manufactured by the Rock Island Bridge and Iron Works, Rock Island, Illinois.

CHAPTER XI

COST LEVELS AND APPLICATIONS OF MICROCOPYING AND PROJECTION READING

There is a final limit beyond which the principle of reducing the size of the reading matter cannot be carried. This limit is reached in "filmslide" or microcopying. The name "filmslide" or "filmstat" has come to be applied to a process of copying on film and reading by projection. The word "microcopying" would be more appropriate if glass should come in as a photographic material.

Resolving Power of Emulsion

The technological limit of reduction of print is fixed by the size of the grain on a photographic emulsion.[1] The dark portions of a photograph are made up of clots of small particles of metallic silver embedded in dry gelatin. The relation between the size of these grains and the possible extent of photographic reduction of reading matter can be graphically illustrated if one imagines that he has before him a level table top and a few handfuls of sand, and wants to form letters on the table top by laying down lines of loose sand. If the sand is very fine-grained, like powder, he will be able to make smaller letters than if the sand is coarse-grained or gravelly. But no matter how fine the sand there will be a limit, a size of letter, in which the grains from the different strokes of the writing will run together, the hollows inside the "d's" and the "e's" fill up. Letters the size of these printed on this page could not be formed from loose sand on a table top, no matter how much care were used. The corresponding limit is found in reducing newsprint on photographic film. When the reduction is carried below twenty diameters, the letters begin to blur over; at twenty-five diameters the blurring is very noticeable; at thirty-six diameters, if the greatest care is used, the words are still sufficiently formed to permit faintly legible enlargements to be made. Beyond that, everything runs together.

Reduction Ratio in Copying

The limit set by the grain of the film to the possibility of making photographic reductions of reading matter can be called the "resolving power" of the film. The standard scientific measure for resolving power is in lines per millimeter, but this proves to be too refined a measurement for studying the practical usefulness of apparatus on the market under normal working or library conditions. Since the final term in the whole process is a legible projected image, a rough index of the legibility of the product can be used to make a comparison of films, cameras and treatments of film. Again the newsprint can be taken as a standard, and the efficiency of a microcopying process or material can be stated in terms of the number of diameters of reduction of 7-point newsprint; this number will be called the "reduction ratio." If the reduction ratio for 7-point newsprint is sixteen diameters, the same material and process should copy 14-point type with approximately equal efficiency at a reduction of 25 to 32 diameters. Note, though, that fourteen-point type is not necessarily twice the size of a 7-point face.

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[1] Mr. Verneur Pratt, of International Filmbook Corporation, comments on this statement: "In our opinion, the size of the grain in the original emulsion is not the technological limit. We believe that the present process positive film, either of Eastman, DuPont, Gaevert, or others, is sufficiently fine to permit of reductions up to fifty diameters....Our experience is that the reason the developing laboratories cannot secure clean-cut and distinct letters at high ratios of minification is found within the process itself... Our contention is that the individual grains are quite small enough for all practical purposes before development; but that when developed in the ordinary manner, these grains clot together in clumps....We believe that the future of microcopies on film lies not at all within the province of present film development methods." Mr. Pratt hoped to eliminate grain entirely, and to produce clean-cut microcopies at practically any ratio of minification. He suggests that the success of M. Dagron in making microcopies during the siege of Paris was based on a processing technique that has become a lost art because of the lack of demand for its perfection.

Many conditions of a page other than the point size of the type will extend or limit the possible reduction ratio. The body of type (whether heavy or light), the spacing of the letters on the line, the whiteness of the paper, the blackness of the ink, the clearness of the edges of the letters--all these things will control the resolving power of a photographic emulsion as applied to the microcopying of a particular page. For every page, however, there is some differential which, for microphotographic purposes, will equate it with newsprint. Some specific handicap in reduction ratio can be allotted, either to the newsprint or the other page, so that newsprint reduced by _x_ diameters is the microphotographic equivalent of the other page reduced _y_ diameters. The reduction ratio is a quantity of fundamental importance governing all cost calculations in film copying. What is the highest practicable reduction ratio?

The limit of the reduction ratio in microcopying is set by three factors: the resolving power of the emulsion on the film or glass; the resolving power of the lens and the mechanical perfection of the camera; and the workmanship in focusing, lighting, timing the exposure, and developing the image.

Process-Positive Emulsion

The most widely used photographic emulsion for microcopying is the one that happens to be the cheapest--the "process positive" emulsion used in making positive prints in moving picture work, or in photogravure. This emulsion is manufactured to respond to the blacks and whites of a photographic negative, and is therefore well adapted to render the contrast of black and white in copying.

For a copying problem in which faded ink or stained or colored paper is involved, a panchromatic emulsion would be preferable. The emulsion used by the Recordak Corporation for microcopying is devised to take care of a wide variety of color contrasts. While not specifically a panchromatic film, it is yet more receptive to color contrasts than ordinary process positive emulsion. DuPont quarter-speed pan or Eastman micro-pan is recommended for work involving color.

There is every prospect that finer emulsions will become available, or that special processing may render the present emulsions capable of higher reduction ratios than they now accept in copying. But it remains to be seen whether the prices of these special emulsions or processings will be sufficiently close to the price of process positive film to make them a desirable substitute. In this chapter, except when otherwise stated, the kind of photographic emulsion under discussion is the process positive.

Camera and Lens System

The efficiency of a camera and lens system in affecting the reduction ratio is a product of three factors: the quality of the lens itself; the adaptation of the mechanism for accurate focusing; and the success of the film-holding mechanism in preventing a slight buckling of the film. All copying cameras save one hold the document still and make exposures one at a time through a lens which covers the whole film area on which the page is copied. The Recordak apparatus uses a different principle: the documents are copied while in motion. The light passes through a slit to the moving film, and falls in a narrow band across the film. This optical system is said to simplify the elimination of distortion near the edges of the film.

It is not easy to isolate these factors in appraising the efficiency of a camera and lens system, but the writer, after some experimentation with a number of cameras, has come to the conclusion that, taking all factors into account, it seems perfectly safe to regard eighteen diameters reduction of newsprint as well within the capacity of most film, apparatus, and workmanship. Eighteen diameters reduction of newsprint should be substantially equivalent to thirty-six diameters reduction of fourteen-point type.

Limits of Reduction Ratio

As an ultimate limit, a reduction of twenty-five diameters of newsprint might conceivably become practical, but at such great reductions another consideration would have to be taken into account; namely, the amount of light that can be forced through a translucent film covered with dry gelatin emulsion without damaging it by overheating.

The Eastman Company, in developing its Recordak copying machines for documents and newspapers, has allowed a certain margin of safety by setting sixteen diameters as its reduction ratio. It also has a document copying machine set to make reductions of seventeen, eighteen and four-tenths, and twenty-three diameters. The choice of certain of these ratios was probably the consequence, not so much of limitations of resolving power as of convenience in that ordinary business documents are 8" wide and will go easily on 16mm. film if reduced seventeen diameters; while the newspapers are 18" wide, and will go evenly on a 35mm. film (perforated on one side only) at the reduction ratio sixteen. The twenty-three diameter reduction is satisfactory for typescript and will put 50% more typescript on a foot of film than seventeen diameter reduction will put on.

In comparing the work of different cameras, an arbitrary scale of legibility was set up, as follows:

A Legibility: All letters distinct.
B Legibility: The edges of the letters begin to blur.
C Legibility: The tops of the "o's" and "a's" are blotted over solid, but the openings are still clear in the "o's", "d's", "p's", and "b's."
D Legibility: Almost illegible. The openings of the "s's", "o's", "d's", etc., are blotted solid. Separate words can be deciphered but not read.
E Legibility: Absolute illegibility.

Then seven film copying devices (these devices will be described in the next chapter) were tested, allowance being made in some cases for better and poorer runs, or for expert and amateur workmanship. The difference between the worst and the best workmanship was much greater than the difference between the worst and the best apparatus. The conclusions of the experiment can be summarized on the following table.

Another way of demonstrating the limits of resolving power is to microcopy a page and then enlarge it back to its original size. The loss of legibility suffered by the reducing and enlarging process will then show itself.

In the following exhibits, typescript and newsprint have been carried by various cameras to varying degrees of reduction and enlarged back to original size. These exhibits require careful explanation. The most instructive one is that prepared by Dr. L. Bendikson and Mr. E. F. Morkisch

TABLE XXXVIII

REDUCTION RATIO AND LEGIBILITY OF PROJECTED IMAGE OF 7-POINT NEWSPRINT PHOTOGRAPHED IN DIFFERENT KINDS OF MICROCOPYING CAMERAS[2]

	A	B	C	D	E
Kennedy machine at highest efficiency	-20	21-24	25-28	29-37	37-
Kennedy machine at lower efficiency			22		
Leica camera (used by an expert)	-18	22 1/2	24-28	29-35	36-
Leica camera (used by an amateur)	-18	20-23		32	
E.K.A. camera (lowest efficiency)	-13	13-15	16-17	17	
E.K.A. camera (highest efficiency)				38	
Filmograph	-16	17-20	21-24	25-28	28-
Recordak (check copying machine)					
Recordak (newspaper copying machine)					
Eastman laboratory				25	
Cinescopie					
Ansco	-15	16-18	19-21	22-25	25-
Draeger					
Dagron's photograph - 1870			48		

[2] The Eastman laboratories estimated on theoretical grounds that the limit of reduction should be about twenty-five diameters for newsprint, and made a test photograph on this scale, which had D legibility.

at the Huntington Library, San Marino, California (Figure LXIIb).

Dr. Bendikson was furnished with a page (Figure LXIIa) upon which four clippings were pasted, and he was asked to reduce this page by 16 diameters with his Leica camera and then enlarge it back to original size. But, as can be seen, two of the clippings were already reduced 50% from original size by photo-offset. Dr. Bendikson was asked to enlarge these reduced clippings back to twice the size in which they came to him. The enlargements are here reproduced as Figure LXIIb. At the top of the page are the two clippings, one of newsprint and the other of typescript, which have been passed through a reduction of 16 diameters; at the bottom of the page are the two clippings, also of newsprint and of typescript, which have been passed through a reduction of 32 diameters. The difference in legibility that appears in the exhibit registers the loss of definition in utilizing the higher reduction ratio.

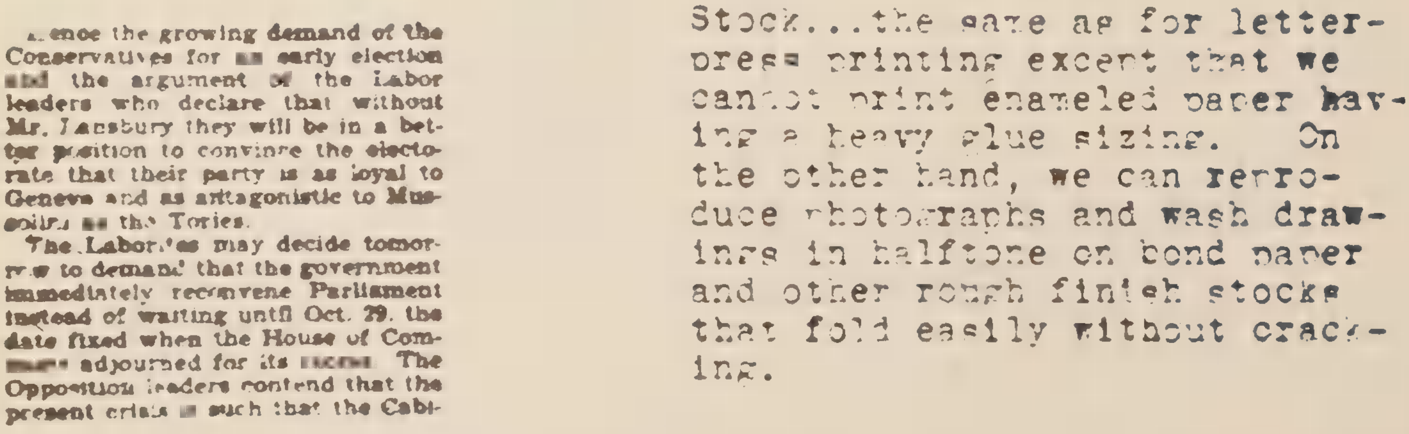
Consider the number of steps, photographic and in printing, that have marked the transmission of the two clippings at the bottom of the page:

1. The original newsprint and typescript were photographed on a negative in a reduction of 50%.
2. This negative was then burnt into the photo-offset metal sheet.
3. The metal sheet was inked and printed via a rubber blanket on paper. (The appearance of newsprint in this reduction can be noted in Figure LIV, a page of the New York Times reduced 50% by photo-offset.)
4. The photo-offset copies of the two clippings were then photographed on film in an additional reduction of 16 diameters, making a total reduction of 32 diameters from original size.
5. The two clippings were then enlarged back 32 diameters on bromide paper.
6. The bromide paper was then photographed full size on a negative for the photo-offset press.
7. The negative was burnt into a metal sheet.
8. The metal sheet was then inked and the ink transmitted via rubber blanket to the page of this book.

The superb photographic craftsmanship of the Huntington Library staff may make the test unfair as a true comparison of apparatus. The clippings reproduced below were microcopied as follows, from clippings of newsprint and typescript by the Folmer Graflex Corporation, in a reduction of 16 diameters, and enlarged back to normal size.

These reproductions are all well within the zone of legibility. But it is otherwise with the clippings that have passed through microcopying from originals that were already reduced 50% (Figure LXIIc). The effective reduction from the

FIGURE LXII



Hence the growing demand of the Conservatives for an early election and the argument of the Labor leaders who declare that without Mr. Lansbury they will be in a better position to convince the electorate that their party is as loyal to Geneva and as antagonistic to Mussolini as the Tories.

The Laborites may decide tomorrow to demand that the government immediately reconvene Parliament instead of waiting until Oct. 29, the date fixed when the House of Commons adjourned for its recess. The Opposition leaders contend that the present crisis is such that the Cabi-

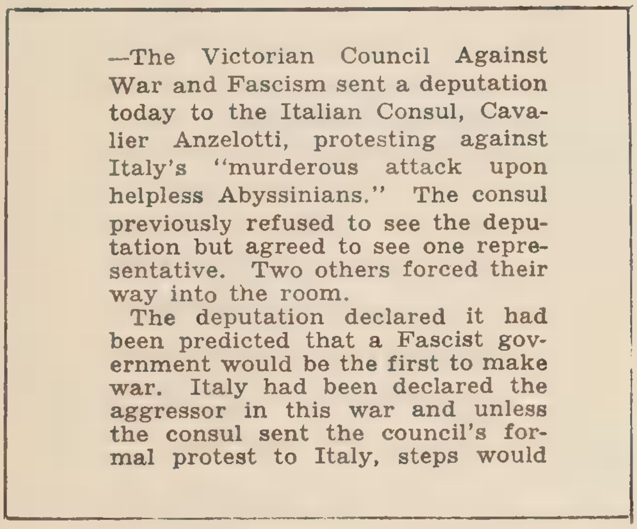
Stock...the same as for letterpress printing except that we cannot print enameled paper having a heavy glue sizing. On the other hand, we can reproduce photographs and wash drawings in halftone on bond paper and other rough finish stocks that fold easily without cracking.

Sixteen diameters reduction and enlargement of newsprint and typescript, by Folmer Graflex Corporation

FIGURE LXIIa

This page was reduced 16 diameters. When so reduced, it was a rectangle the size of this figure: The two upper squares on the page were then enlarged back exactly 16 diameters. The two lower squares on the page were enlarged back 32 diameters, because the clipping and the typescript had been reduced to 50% of original size by photo-offset before they were again reduced by photography; therefore the total microphotographic reduction was 32 diameters, and an enlargement of 32 diameters was necessary to bring them back to full size.

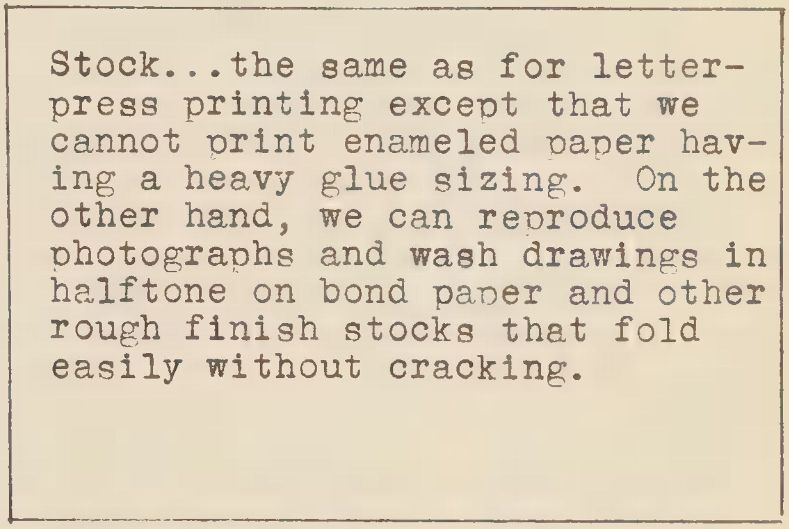
Photo-offset reproduction of newsprint reduced 16 diameters and enlarged back 16 diameters.



—The Victorian Council Against War and Fascism sent a deputation today to the Italian Consul, Cavalier Anzelotti, protesting against Italy's "murderous attack upon helpless Abyssinians." The consul previously refused to see the deputation but agreed to see one representative. Two others forced their way into the room.

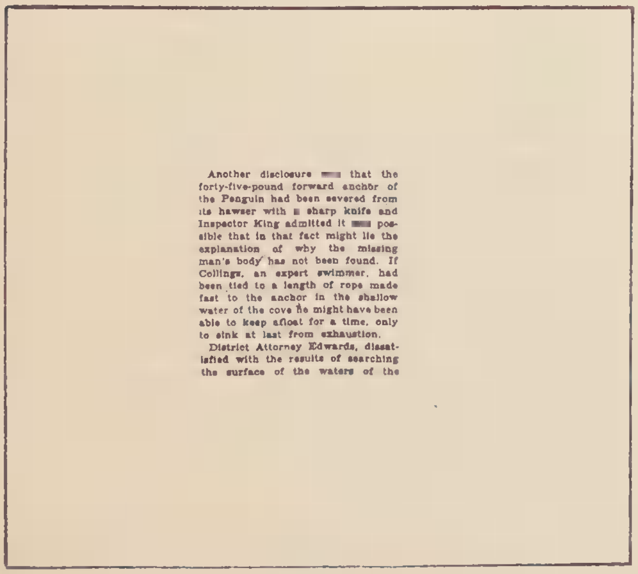
The deputation declared it had been predicted that a Fascist government would be the first to make war. Italy had been declared the aggressor in this war and unless the consul sent the council's formal protest to Italy, steps would

Photo-offset reproduction of typescript reduced 16 diameters and enlarged back 16 diameters.



Stock...the same as for letterpress printing except that we cannot print enameled paper having a heavy glue sizing. On the other hand, we can reproduce photographs and wash drawings in halftone on bond paper and other rough finish stocks that fold easily without cracking.

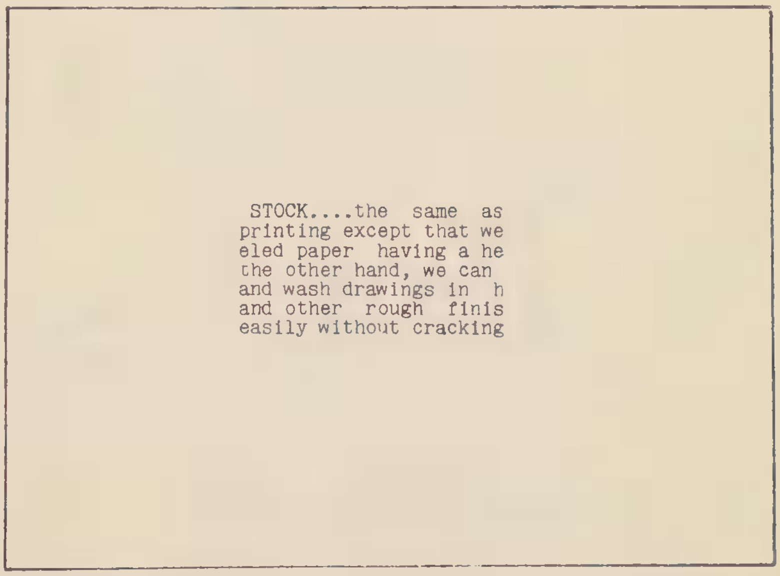
Photo-offset reproduction of newsprint reduced 50% by photo-offset, then reduced 16 diameters by photography and enlarged back 32 diameters.



Another disclosure [illegible] that the forty-five-pound forward anchor of the Penguin had been severed from its hawser with [illegible] sharp knife and Inspector King admitted it [illegible] possible that in that fact might lie the explanation of why the missing man's body has not been found. If Collings, an expert swimmer, had been tied to a length of rope made fast to the anchor in the shallow water of the cove he might have been able to keep afloat for a time, only to sink at last from exhaustion.

District Attorney Edwards, dissatisfied with the results of searching the surface of the waters of the

Photo-offset reproduction of typescript reduced 50% by photo-offset, then reduced 16 diameters by photography and enlarged back 32 diameters.



STOCK....the same as
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the other hand, we can
and wash drawings in h
and other rough finis
easily without cracking

This page was sent to various photographers as a test sheet; this original is here reproduced directly by the photo-offset process; the following exhibit, Figure LXIIb, has been passed through a reduction of sixteen diameters and an enlargement of sixteen and thirty-two diameters.

FIGURE LXIIb

This page was reduced 16 diameters. When so reduced, it was a rectangle the size of this figure: The two upper squares on the page were then enlarged back exactly 16 diameters. The two lower squares on the page were enlarged back 32 diameters, because the clipping and the typescript had been reduced to 50% of original size by photo-offset before they were again reduced by photography; therefore the total micro-photographic reduction was 32 diameters, and an enlargement of 32 diameters was necessary to bring them back to full size.

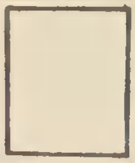
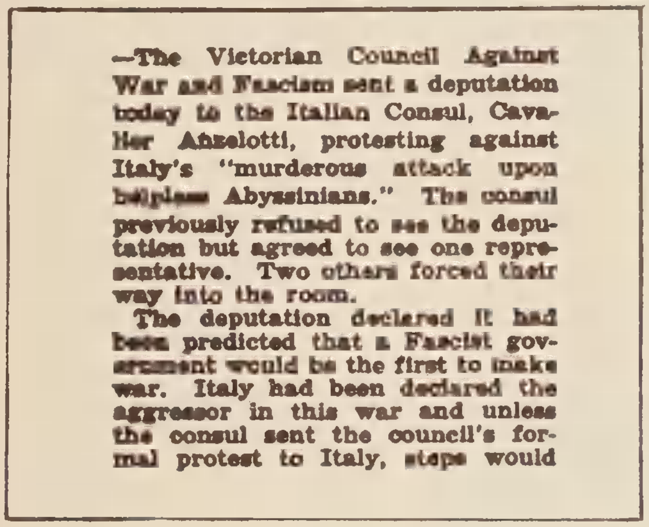


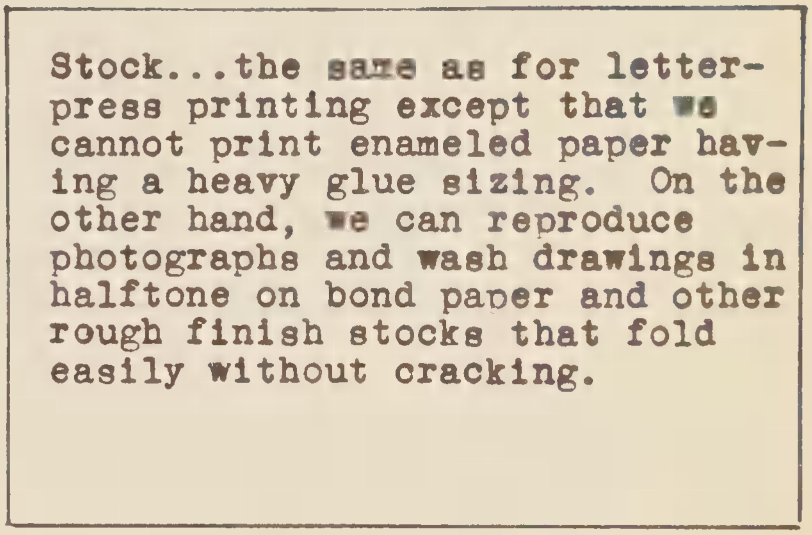
Photo-offset reproduction of newsprint reduced 16 diameters and enlarged back 16 diameters.

Photo-offset reproduction of typescript reduced 16 diameters and enlarged back 16 diameters.



—The Victorian Council Against War and Fascism sent a deputation today to the Italian Consul, Cavalier Anzelotti, protesting against Italy's "murderous attack upon helpless Abyssinians." The consul previously refused to see the deputation but agreed to see one representative. Two others forced their way into the room.

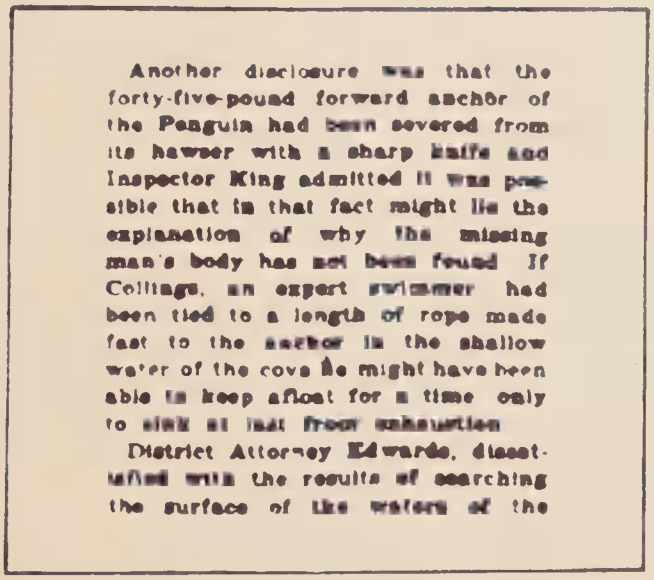
The deputation declared it had been predicted that a Fascist government would be the first to make war. Italy had been declared the aggressor in this war and unless the consul sent the council's formal protest to Italy, steps would



Stock...the same as for letterpress printing except that we cannot print enameled paper having a heavy glue sizing. On the other hand, we can reproduce photographs and wash drawings in halftone on bond paper and other rough finish stocks that fold easily without cracking.

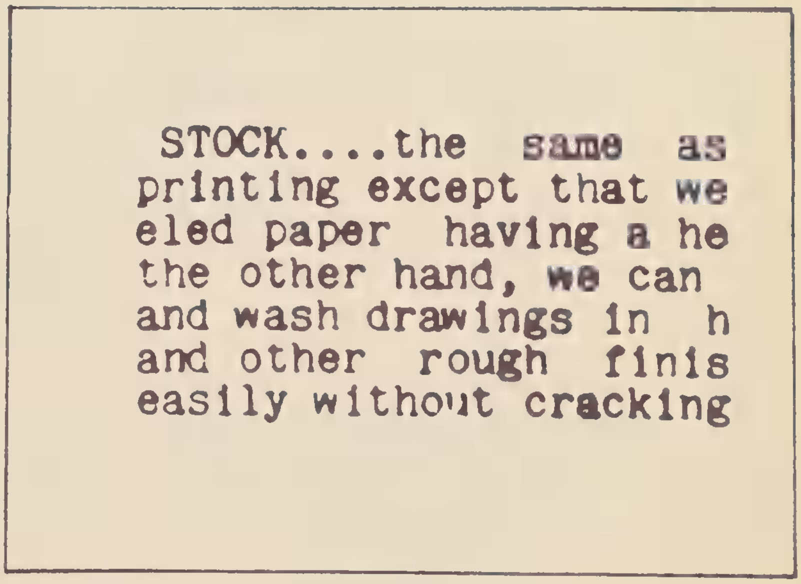
Photo-offset reproduction of newsprint reduced 50% by photo-offset, then reduced 16 diameters by photography and enlarged back 32 diameters.

Photo-offset reproduction of typescript reduced 50% by photo-offset, then reduced 16 diameters by photography and enlarged back 32 diameters.



Another disclosure was that the forty-five-pound forward anchor of the Penguin had been severed from its hawser with a sharp knife and Inspector King admitted it was possible that in that fact might lie the explanation of why the missing man's body has not been found. If Collinge, an expert swimmer had been tied to a length of rope made fast to the anchor in the shallow water of the cove he might have been able to keep afloat for a time only to sink at last from exhaustion.

District Attorney Edwards, dissatisfied with the results of searching the surface of the waters of the



STOCK....the same as
printing except that we
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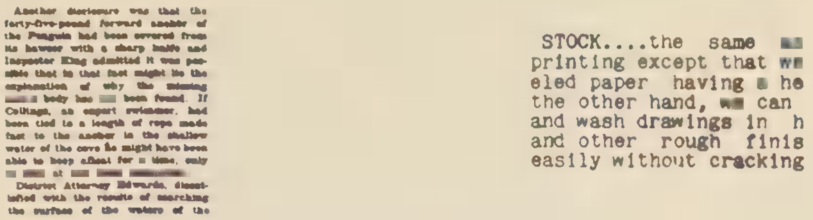
the other hand, we can
and wash drawings in h
and other rough finis
easily without cracking

This page was photographed with a Leica Camera, at the Huntington Library, San Marino, California, under the supervision of Dr. L. Bendikson, by E. F. Morkisch.

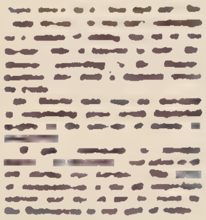
FIGURE LXIIc



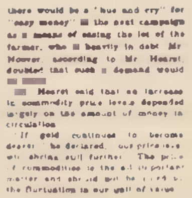
STOCK....the same [illegible]
printing except that [illegible]
eled paper having [illegible] he
the other hand, [illegible] can
and wash drawings in h
and other rough finis
easily without cracking

Newsprint and typescript reduced a net thirty-two diameters from original size and enlarged back sixteen diameters, by Dr. Bendikson with Leica equipment.

Newsprint reduced a net thirty-two diameters from original size and enlarged back sixteen diameters. Reductions by Recordak Corporation, and enlargements by amateur photographer.

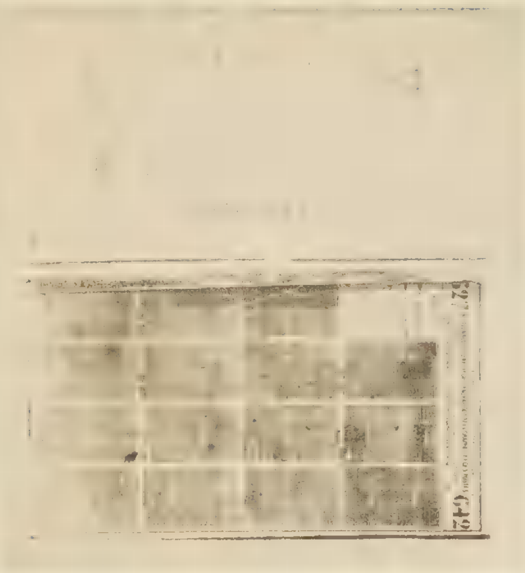


Newsprint reduced a net thirty-two diameters from original size and enlarged back sixteen diameters, by Folmer Graflex Corporation with its recording camera.

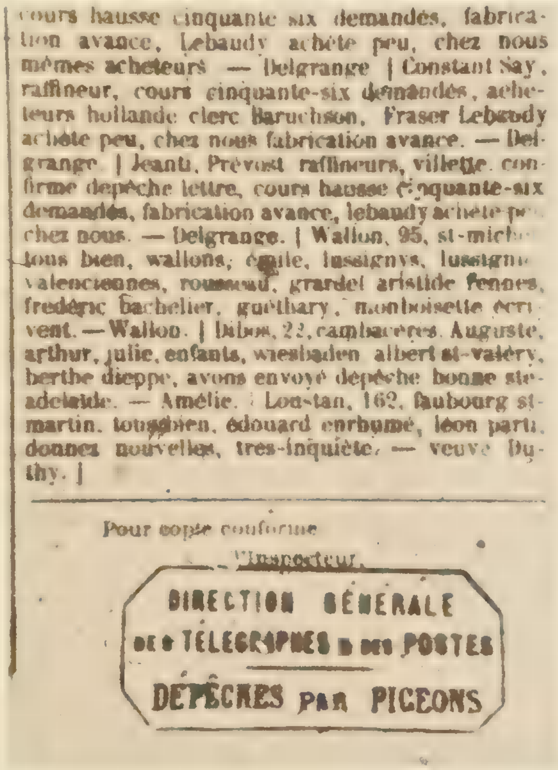


Newsprint reduced a net sixteen diameters from original size and enlarged back eight diameters, by Folmer Graflex Corporation with its recording camera.

FIGURE LXIIIa



Full-Tone Collotype Reproduction of a Contact Print of the Dagron Film, Showing its Exact Size.



cours hausse cinquante six demandés, fabrication avance, Lebaudy achète peu, chez nous mêmes acheteurs — Delgrange | Constant Say, raffineur, cours cinquante-six demandés, acheteurs hollande clerc Baruchson, Fraser Lebaudy achète peu, chez nous fabrication avance. — Delgrange | Jeanti, Prévost raffineurs, villette confirme dépêche lettre, cours hausse cinquante-six demandés, fabrication avance, lebaudy achète pe chez nous. — Delgrange. | Wallon, 95, st-mich tous bien, wallons, émile, lussignys, lussign valenciennes, rousseau, grardel aristide fennes, frédéric bachelier, guéthary, monboisette écrivent. — Wallon. | Dubos, 22, cambacérès. Auguste, arthur, julie, enfants, wiesbaden albert st-valéry, berthe dieppe, avons envoyé dépêche bonne ste-adelaide. — Amélie. | Loustan, 162, faubourg st-martin. tous bien, édouard enrhumé, léon parti, donnez nouvelles, tres-inquiète. — veuve Duthy. |

Pour copie conforme

L'Inspecteur.

DIRECTION GÉNÉRALE
DES TÉLÉGRAPHES ET DES POSTES
DÉPÊCHES PAR PIGEONS

Full-Tone Collotype Reproduction of a Thirty-two Diameter Enlargement of a Part of One of the Sections of the Dagron Film, Showing Legibility Despite High Original Reduction Ratio.

original text in the case of these clippings is double that of the reduction in the clippings on Figure LXIIb. They have not been enlarged back to the original size of the texts from which they were drawn, but remain in a half-size reproduction. In most cases, the eight stages of transmission through which they have passed have obliterated all legible qualities.

The following clippings are reproduced as Figure LXIIc.

1. Clipping reduced a net 32 diameters from original and enlarged back 16 diameters, to 50% of its original size, by Dr. Bendikson with Leica equipment.
2. Clipping reduced in the same amount and enlarged back in the same way with Recordak camera and amateur enlargement photography.
3. Clipping reduced a net 32 diameters from original and enlarged back 16 diameters, to 50% of original size, by Folmer Graflex Corporation.
4. Clipping reduced a net 16 diameters from original and enlarged back 8 diameters, to 50% of original size, by the Folmer Graflex Corporation with its recording camera.

One of the most extraordinary uses of microcopying, and seemingly one of the most efficient in the history of photography, was the work of Monsieur Dagron during the siege of Paris in 1870. Dagron's postal service into the beleagured city was set up to use carrier pigeons. To increase the number of words a pigeon could carry, messages were printed on a large sheet of paper and microphotographed on film. The film was then inserted in a quill and carried by the pigeon. A piece of this film came into the hands of Dr. Bendikson of the Huntington Library. The fragment printed herewith is an enlargement of 32 diameters from the film. The exact size of the film, which contains eleven pages of three columns each, is also shown. There is no direct evidence to establish the size of the print from which the microphotograph was made, but by counting the letters in a line, and the number of columns per inch, it is possible to estimate that the vertical dimensions of the original typography must have been about the same as modern newsprint, and the horizontal dimension somewhat smaller. The reduction from which this enlargement was made must have been the equivalent of something between 32 and 39 diameters from newsprint.

Cost of Photosensitive Surface

The cost of the photographic surface used in microcopying varies between $.14 and $.50 per square foot. The cheapest film is the motion picture nitrate film which sells for $.01 a running foot, 35mm. wide; but this is, or ought to be, excluded from consideration. No nitrate film should ever be used for copying work, for the cellulose nitrate upon which the emulsion is spread is highly unstable in the presence of heat. In its chemical composition it is a half-finished high explosive, like a dynamite stopped halfway in the course of manufacture. It cannot be preserved with safety except in expensive vaults and it always brings a fire risk with it.

The so-called "safety film" or cellulose acetate has a fire resistance about the same as that of paper of similar density. Hold a match to a sheet of dry cellulose acetate and it will crumble but it will not sustain a flame. It has high stability--Mr. B. W. Scribner of the Bureau of Standards has stated--equal to the best-made papers. Safety film is sold ordinarily at $.015 a running foot in the 35mm. width. It can sometimes be purchased from firms dealing in odd lengths for a lower price, but the $.015 is standard, whether for perforated or unperforated film. If the film is perforated on both sides, one inch is usable between the perforations; this figures out at $.18 per square foot of usable photographic surface; if the film is perforated on one side only, 1 1/8" out of the 35mm. are usable, and this makes the usable surface cost $.1605 per square foot. For unperforated film, with 1 1/4" usable, the price per square foot comes to $.144.

The 16mm. film, perforated on one side only, is sold for $.0075 a foot; the usable width is .43" to .5"; therefore the price of a usable square foot (28 linear feet) is $.21 at the highest, or $.18 at the lowest. The 70mm. film, perforated on both sides, is supplied on special order at $.035 a running foot, or $.185 per square foot.

A slightly different emulsion with a different weight of supporting film is manufactured for use in photoengraving work and sold by a different method. Because of these differences, the process film cut in rectangles is sold at a higher price. A dozen sheets, 5" x 7", retail for $1.45 list price. Discounts in the trade will reduce this in large quantity orders, so that the photographic surface in this form costs $.50 per square foot in small quantities, $.325 per square foot in large quantities. The same emulsion on glass is sold for the same price in the same size.

The tabulation of these figures indicates the price range of translucent photographic surfaces, whether in the form of film or glass, of rectangles or long strips:

TABLE XXXIX

PRICE PER SQUARE FOOT OF USABLE SURFACE

35mm. moving picture film, perforated both sides	$ .18
35mm. moving picture film, perforated one side	.16
35mm. moving picture film, unperforated	.144
16mm. moving picture film, perforated one side	.18-.21
70mm. moving picture film, perforated both sides	.185
5" x 7" process film or glass (large lots)	.325
5" x 7" process film or glass (small lots)	.50

A strip of the 16mm. and a strip of 35mm. film are shown in the accompanying sheets.

These figures for translucent surface are to be compared with those for photostat or bromide paper. Insurance bromide paper sells for $3.60 per gross cut 8" x 10", or $.045 per square foot. The same price, or in some cases $.005 more or less, buys most kinds of photostat paper. The difference between $.045 and the prices listed above is paid for the purpose of having the photographic image on a translucent medium. Translucency costs from $.10 to $.28 a square foot.[3]

Film or Glass Versus Paper

Why is it desirable to use a translucent medium in copying? One part of the answer to this question is found in the behavior of light. In discussing the possibilities of reading reduced-size print by means of a reading glass, it was stated that a "direct" optical system can be used in raising the ostensible size of the letters one diameter, but that it soon comes to call for more intensive light on the surface of the paper than would be required if no magnifying were done. The same principle, pressed one degree further, will permit a legible image of a page to be projected from a paper copy by reflection in a projection lantern if sufficient light is focused on the paper. As the enlarging ratio increases, it approaches and reaches the point where the surface of the paper will not reflect sufficient light to make the projected image legible. At this point the translucent medium becomes useful, for light sufficient to render legible a projected image of a reduction up to 25 diameters (and perhaps beyond that) can be forced through the film or the glass. The additional cost of the translucent photographic medium must justify itself by the increased utilization of light in the projection process, which renders possible the greater reduction ratios that are standard in microcopying.

Film, Glass or Paper? Film Strips or Rectangles?

The basic comparison of the three

---

[3] Paper in 70mm. strips sells for twice the price of ordinary photostat rolls, but a simple frame with a razor blade set in it, will cut the paper in these strips, making the low price available.

THE USE OF 16 MM. FILM IN LIBRARY WORK

In the past year, considerable progress has been made in equipment and technique for copying various records on film. The technique of micro-copying, combined with the use of WPA labor, opens a new field for achievement of large-scale objectives, hitherto abandoned as too expensive for the average institution.

The Recordak Corporation, of 350 Madison Avenue, New York City, using regular commercial equipment and specially developed equipment has done considerable work along this line. Sometime ago, Recordak equipment was used to photograph the NRA and AAA hearings in Washington on 16mm. film. Positive copies of this film record were sold to libraries throughout the country.

Recently, Dr. T. R. Schellenberg and others, with the cooperation of the Recordak Corporation, worked out a plan for the photographing of library cards. The general procedure as planned involves the filming of the catalogues of all the libraries in a region, and the typing of library cards from the film copies to make a master catalogue. For the reading of the film, the typists use Recordak projectors, which enlarge the film copies to original size.

For $5.50 worth of film (200 feet), including developing, 10,000 library catalogue cards can be copied. The plan is ideal, as cards can be photographed at a high rate of speed with absolute accuracy, minimum disturbance of library routine, simplicity of operation, and at a lower cost than could possibly be attained with any other method. Two large centers, Cleveland and Philadelphia, are pioneering in this field by making union catalogues of their library holdings.

The attached film contains pictures of a number of standard library cards.

PRESERVATION OF NEWSPAPERS BY PHOTOGRAPHY

(Reprinted, by permission, from
Bulletin of American Newspaper
Publishers Association)

By W. E. WINES,
Manager Mechanical Department

A photographic method and apparatus for reproducing newspaper pages in reduced size, so that newspaper files may consist of small reels of negative film instead of bulky bound volumes, has been announced by Eastman Kodak Company and was exhibited in New York by Charles Z. Case. This is a development of the Recordak system which has been in use for eight years by banks and mercantile companies for making photographic records of checks and bills. The process consists of two steps or stages. The pages of any issue are first photographed consecutively on a sensitized film 1⅜ inches wide, by means of a special camera which photographs the pages with great rapidity—approximately 30 pages a minute. For viewing the film, a special projector or viewing apparatus has been devised which produces an image the linear dimensions of which are 1½ times those of the original printed page. A column 2 inches wide is enlarged by the projector to 3 inches and the height of the letters is magnified in the same ratio.

THE FILM.

The film used is similar to the standard 35-mm. film used in professional moving picture cameras but differs in two important particulars. The first is that the base which carries the sensitive emulsion is the non-inflammable cellulose acetate, used in amateur movie cameras, instead of the highly combustible cellulose nitrate, commonly used for professional moving picture work. Mr. Case says that the National Board of Fire Underwriters rates this "safety" film as offering no more fire hazard than the same quantity and form of newsprint. The second

RECORDAK CORPORATION
SUBSIDIARY OF EASTMAN KODAK COMPANY
350 MADISON AVENUE
NEW YORK

Briefly stated, the outstanding advantages of this method are:

A tremendous reduction in space required to house newspaper files. The film record requires less than 2% of the storage space required by the original bound volumes.

The film record is a much more permanent one than the present bound volumes. This record can be renewed as desired thus preserving the files indefinitely.

The files can be referred to much more easily with the new method. They can be retained where they are immediately available and the moving about of large bound volumes is eliminated.

The cost is exceedingly small - being only 1-1/5¢ per page for standard size newspaper pages. Consequently 1,000 pages will cost only $12.00 which is little more than the present binding cost.

RECORDAK CORPORATION

difference is that this film is perforated on only one edge, thus allowing more usable area on the same total width. One foot of film negative carries eight and a fraction newspaper pages or approximately 825 to 850 pages on 100 feet of film. The pages are arranged lengthwise on the film.

THE CAMERA.

The camera, which might more properly be called a photographing machine, is almost wholly automatic in action. The newspapers to be photographed are fed in one page at a time, very much as sheets are fed into a cylinder press or mimeograph. Since the photographing of an entire month's edition will require only thirty minutes, more or less, it would hardly pay any newspaper to purchase one of these cameras. Newspaper publishers ship the month's file of newspapers to Rochester each month and pay for the negative film at a price of 10 cents per foot. If more than one film is desired from the same lot of papers, duplicates are made at a cost of 5 cents per foot. These prices cover the film itself as well as the items of exposure and development. This charge for the first negative is equivalent to 1⅕ cents per page, and for the positive duplicate copies, ⅗ of a cent per page.

A reel of one hundred feet of film occupies a storage space 1⅝x3¾x3¾ inches and carries at least 850 newspaper pages. When asked concerning the life of the film, Mr. Case replied that no one really knows how long a negative film will last, as none has yet become useless from age. It may last 100 years or more. As it is a comparatively simple and inexpensive matter to duplicate the film at any time, the length of life of film is not really a vital matter. Mr. Case also stated that bound volumes of old issues can be reproduced and preserved by this method, but that to do so it would be necessary to take the volumes apart.

THE PROJECTOR.

The projector or viewing device is shown in the accompanying illustration. The base measures approximately 15 by 18 inches, and the total height is a little over 3 feet. The reel of film is mounted on a carrier on top of the apparatus, as shown, and is unwound and rewound as desired by means of a crank mounted on the right side of the casing, as is shown in the illustration. Since the pages are arranged in consecutive order on the film, any page desired may be easily and quickly located. The projector shows both 16 and 35 mm. film.

In the base of the projector is a roll of dull surfaced paper 15 inches wide. The free end of this roll is pulled over the base and forms the screen upon which the film pictures are projected. As the surface becomes soiled a clean section is pulled down and the soiled portion is torn off. The screen shows one-quarter of a newspaper page at a time.

It will be noticed from the illustration that four columns of an 8-column page are visible. The knob and lever mounted on the left side of the case are employed for shifting the film, carrier and optical system forward or backward or to right or left so as to bring into the field of view the exact portion of the page which the operator desires to read. Records photographed on 16 mm. film appear in their entirety on the screen. The source of light is a 200-watt lamp protected by a guard as shown. The apparatus is designed to prevent injury to the film by heat, no matter how long the film may be exposed to the light of the lamp. The cabinet protects the image on the screen from interference by extraneous light sources, thus allowing the projector to be used in any room under normal lighting conditions.

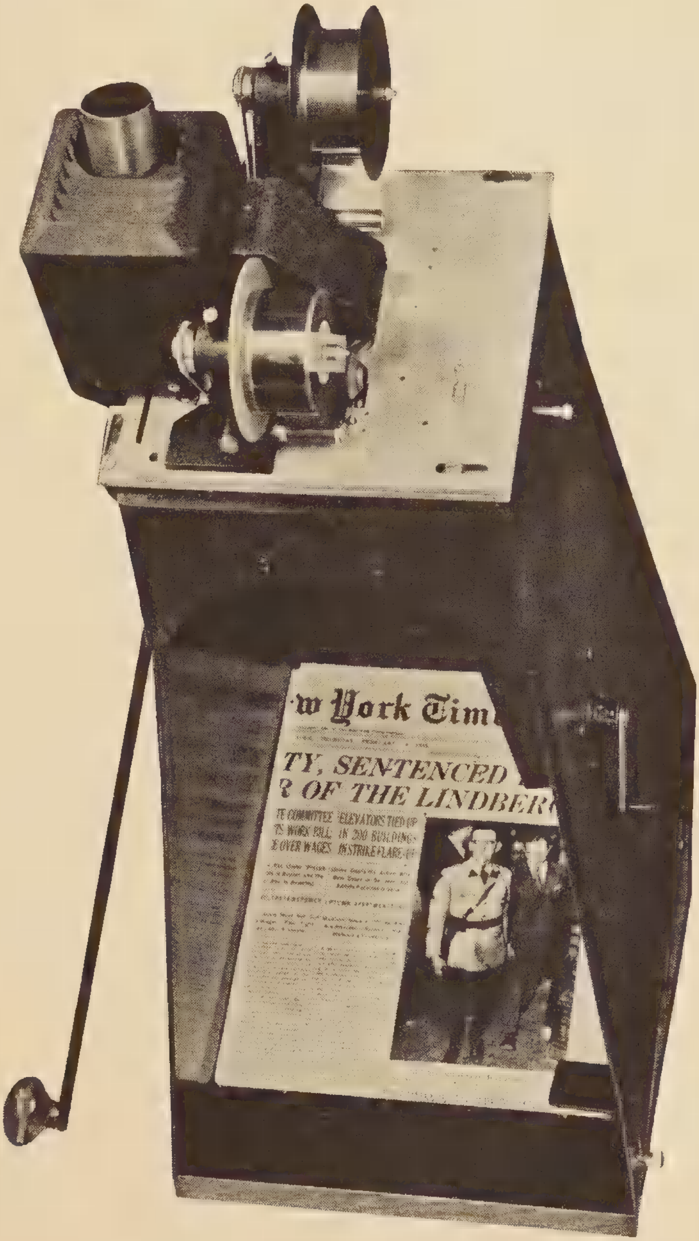
If a copy of any particular article or story is desired, this can be obtained photographically by laying a piece of photographic paper on the screen so that the sensitized surface receives the image. If a print of a whole page is desired, this may be made from the negative by the process commonly employed for making enlarged photographic prints. The price of the projector is $185.00.

Newspapers in various parts of the country are now photographing their editions by the Recordak method and are using Recordak Library Projectors for reading the film. Several libraries are now using film copies of newspapers that they ordinarily kept on their shelves in bound form. The use of film copies materially reduces the space required to house the bound volumes, eliminates the cost of binding and provides a permanent record. These libraries are using Recordak Library Projectors for reading from the films.

Recently the Recordak Corporation photographed the editions of the New York Times from January 1, 1914, to December 31, 1918. Positive copies of this New York Times film for the 5 years of the World War have been ordered by a number of libraries. The cost of the film copies for the entire 5 years is $433.74. Individual years may be purchased if desired.

(*This reprint contains revised prices and descriptions of equipment.*)

(*For additional information, address Recordak Corporation, Subsidiary of Eastman Kodak Company, 350 Madison Avenue, New York, N. Y.*)



THE PROJECTOR

possible reduced-scale copying methods from the standpoint of costs of surface can be established if we consider the cost of copying 256 square feet of printed matter (the equivalent of 93 pages of the New York Times, or of an octavo book of approximately 300 pages). It is evident that this amount of printed matter can be copied at different reduction ratios on areas of photographic surface at the following costs:

TABLE XL

COMPARATIVE PRICES OF PHOTOGRAPHIC SURFACE ON PAPER, GLASS, AND FILM; WITH REDUCTION RATIOS TO BRING PRICES TO COMMON LEVELS. FIGURES FOR 256 SQUARE FEET OF PAGES REDUCED PHOTOGRAPHICALLY BY THE FOLLOWING REDUCTION RATIOS

	6	8	11	16	22 1/2
Price of 5" x 7" glass				\$.32 1/2	\$.16
Price of 35mm. film, perforated one side			\$.32	\$.16	\$.08
Price of photostat paper	\$.36	\$.18			

It is worth noting that the lower threshold for reading glass legibility, set in the preceding chapter at 7 diameters reduction from typescript, would permit the copying of this 256 square feet of paper on 5.2 square feet of photographic surface, the price of which would be \$.23. If the photostatic reduction on paper were to be four diameters, the price of the paper would be \$.72; a reduction of two diameters (i.e., to one-half normal size) would require photostat paper costing \$2.88.

These figures indicate a very interesting problem in planning the use of photography in scholarship. The zone from 6 to 8½ diameters of reduction on paper corresponds in materials cost to the zone of 11 to 16 diameters on film, 16 to 22½ diameters on glass. Processing costs under present conditions probably give additional advantages to the film strips in the case of a long series of pages that will fill 100 feet or more of film, but this advantage in favor of film may be reversed in the case of short items, especially when a number of positive copies are required.

Reading apparatus for paper in reductions of 6 to 8 diameters has not been developed as far as that for film in reductions of 16 diameters; there is no reading apparatus at all for glass, and reading machines for film positives made from rectangular glass plates with multiple exposures have not yet been brought to perfection in design. Storage and filing of paper in short items may prove less costly than storage and filing of film; glass would probably cause higher storage costs, but would have possible advantages in durability. The fundamental choice between the long strip and the rectangle, between paper, film and glass, between the low reduction ratios required by paper and the high ratios permitted by glass are not conclusively indicated by the present state of technology and experiment. But precisely because the use of moving picture film has been more highly developed as a quantity industry, it is to this medium that most of the experiment and development has been directed, and consequently it is in terms of the use of this medium that the whole problem of microcopying can be best presented at this time.

For that reason the analysis of the possibilities of microcopying on the following pages will assume standard moving picture film in the standard widths of 16mm., 35mm., and 70mm. as the norm, and treat paper and glass or rectangular film as possible exceptions.

The Simplified Practice Division of the Department of Commerce has asked for an agreement by all those promoting microcopying to adapt all apparatus to the 16mm. and

35mm. widths. In replying to the Division of Simplified Practise recommendation, circulated in September 1935, the writer, as chairman of the Joint Committee on Materials for Research, made the reservation that simplified practice should not exclude at this time a size of film that will permit of vertical filing, and coördinate with the use of paper and glass. But for the copying of a long fixed series of material, it seemed best to concur in this standardization of film width. A "long fixed series" is any amount of documentation that will require 100 feet or more of film for copying, and will not call for the insertion of a newly photographed item between two items already photographed.

Full Use of Area of Moving Picture Film

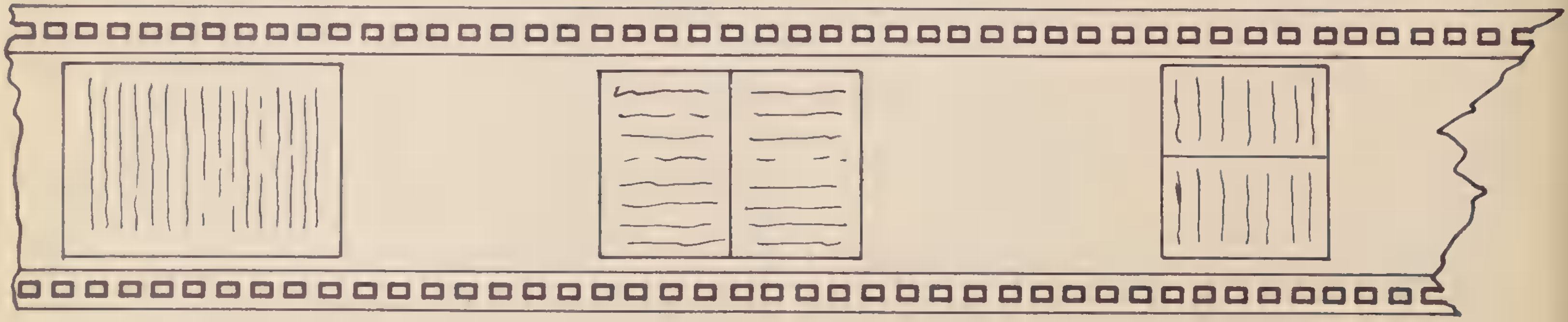
When 16mm., 35mm., or 70mm. film is used for microcopying, one dimension of the photographic image is rigidly fixed; it cannot exceed the usable width of the film, nor can it be less than the width of the film without causing a wastage of photosensitive surface. The dimension along the length of the film is variable provided the photographing is done in a camera, such as the Filmograph or Recordak, which permits the operator to vary the amount of film used at each exposure. But the crosswise dimension is fixed, and therefore, attention must be given to the placing of the photographic image on the film. The same principle of maximum use of area that was found operative in photo-offset work is applicable to microphotography. Just as it is wasteful to print a 6" x 9" book on an 11" x 17" photo-offset metal sheet, so it is wasteful to make on 35mm. film an image only 3/4" wide.

There are three, or possibly four positions in which book pages may be copied on moving picture film. The position chosen for photographing a book on the full width of the film determines the reduction ratio. The three positions, hereafter called first, second and third, are illustrated on the following diagram.

The relation of these book positions to the reduction ratios can be illustrated by calculating the reduction ratio of a book 6" x 9" in all three positions on the two kinds of film, 35mm. and 16mm. The corresponding variation in cost of photosensitive surface can be illustrated by calculating the footage and price of film necessary to copy 100 pages in each of the positions and on each of the widths of film.

Verneur Pratt, president of the International Filmbook Corporation, has proposed that the reading material might be arranged in a fourth way--the lines of print running across the film, making a column the full length of the film but leaving space on the film for more than one column.

If Mr. Pratt's plan for multiple exposures on strips should be applied to 70mm. film, from 8 to 12 columns of ordinary book pages reduced 16 to 20 diameters could be run on the width of the film. There is at present no apparatus for making photographs in this way, but the price of film for 100 pages can none the less be calculated. A hundred pages would go on 4½ to 9 linear inches of film, the price of which would be $.015 to $.0275.



First Position
6 diameters reduction
of 6" x 9" book

Second Position
9 diameters reduction
of 6" x 9" book

Third Position
12 diameters reduction
of 6" x 9" book

TABLE XLI

FILM FOOTAGES REQUIRED IN COPYING BOOKS IN DIFFERENT POSITIONS ON 35mm. FILM (PERFORATED ON BOTH SIDES) AND 16mm. FILM, USING FULL WIDTH OF FILM

Film	Position	Reduction Ratio to use Full Width of Film	Film Footages for 100 Pages of Book		Price of Film
			Feet	Inches	
35mm.	First	6 diameters	12 1/2 or	150	.1825
35mm.	Second	9 diameters	5 1/2 or	66	.0825
35mm.	Third	12 diameters	3 1/6 or	38	.0475
16mm.	First	12 to 14 diameters*	6 1/4 or 5 5/12 or	75 or 65	.047 or .0412
16mm.	Second	18 to 21 diameters	2 3/4 or 2 5/12 or	33 or 29	.021 or .02
16mm.	Third	24 to 28 diameters	1 1/2 or 1 1/3	16	.012 or .01

*The variation in 16mm. film turns on the width of usable surface, whether .5" or .43".

Processing Costs

The processing costs for microcopies are like the costs of the photographic surface in that they apply to a footage of film strips, or, roughly, an area of film.

There are two kinds of processing involved in microcopying: first, the developing and fixing of the negative; and second, the making of contact or other prints from the negative. If a unique copy only of a book or document is desired, there is no need for the second processing.

The commercial processing of film has been organized in two kinds of business enterprise. Short strips of film are processed for the amateur photographer by services available in every drug store. Long runs of moving picture film are processed at prices that may be much less per film area than those charged by the ordinary service.

The short five-foot strips of film used in such cameras as the Leica and Contax can usually be developed (but not printed as positive contact prints) at the corner drug store. The charge is usually $.15 or $.20--hence $.03 or $.04 a foot. One New York specialist in developing the five-foot rolls charges $.30 or $.06 a foot. Many users of these small microcopying cameras do their own processing.

Film strips of 100 feet or more in length can be processed in the film laboratories serving the moving picture industry. Quotations from a number of laboratories, analyzed to make allowance for various special charges connected with sound track printing, establish the following scale:

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TABLE XLII

PRICES OF FILM PROCESSING

	Processing Alone	Including Film
For developing 35mm. film, per foot	1¢ to 4¢	2 1/2¢ to 5 1/2¢
For making a 35mm. contact print, per foot	1¢ to 4¢	2 1/2¢ to 5 1/2¢
For developing 16mm. film, per foot	1¢	2 1/4¢ to 5¢
For making a 16mm. contact print, per foot	1 1/2¢ to 4 1/2¢	
For reducing a 35mm. negative to a 16mm. positive, price inclusive of cost of 16mm. film, per footage of 35mm. film		1 1/4¢ to 2¢

The variation in prices is not only a difference that appears from firm to firm, but also responds to differences in footage, and in number of prints to be taken from the same negative. The minimum prices appear at 10,000 feet of film where this is the basis of the differential, or at five prints from the same negative where the differential is based on number of prints.

The Recordak Corporation operates on a somewhat different basis; it sells the film and processing as one unit and throws in a metal reel and pasteboard box container to boot. The price of 200 feet of 16mm. film is $5.50, which includes the processing. The film is not the ordinary positive emulsion, and is not available without the processing. But if it were quotable at $.0075 a foot, the processing and servicing elements in the price would stand at $.0188 a foot. This price includes not only special processing for contrast and permanence, but also servicing in the cutting of short strips of film, packaging, and mailing.

The Recordak Corporation also offers for sale 35mm. prints of certain newspaper files. The file for the New York Times has been microcopied for the years 1914-1918 inclusive--a total of almost 90,000 pages; the set of films is on sale for $.66 per 100 pages. Figures presented by the Recordak Corporation during the planning of this project indicated that that part of the cost which is represented by the printing off of the positive copies (not including price of the film) is figured at $.04 per foot.

In estimating processing costs of the long rolls of film, account must be taken of the possibility that this work may be done by the individual or institution which does the photographing. The large, continuous process machines used in the moving picture industry would not be practicable for such work, but a Stineman developing reel, taking 100 feet of film, can be purchased for $32.00; the chemicals for developing 100 feet of 35mm. film cost about $.10. Automatic printing machinery for the 100-foot film strips is also available, and is not too bulky to be part of the equipment of a photographic department of a library.

Processing costs, like reduction ratios, introduce a very significant variable into microcopying. The lower priced processing may or may not be inferior to the more costly. The effect upon costs is illustrated by taking the figures on film footage required for 100 pages of a 6" x 9" book, as given above, and figuring in with them the high and low processing costs. Note that high processing costs can make it more expensive to copy at the reduction ratio of 21 diameters on 16mm. film than to copy with lot processing costs at a reduction of 12 diameters on 35mm. film. The gains in cost of materials that may be made by increasing the reduction ratio may conceivably be frittered away if the high reduction ratio renders necessary a more expensive processing. On the other hand,

TABLE XLIII

EFFECT OF VARIATION IN PROCESSING COSTS ON PRICE OF MICROCOPY POSITIVE
OF A BOOK OF 100 PAGES, 6" x 9", IN VARYING REDUCTION RATIOS
(16mm. film calculated at .43" width of usable surface)

Reduction Ratio	Footage of Film	Price of Film and Processing	
		Low (2 1/2¢ for 35mm. $.025 2 1/4¢ for 16mm. .0225	High $.05
6	35mm. 150 inches	$.3125	$.625
9	35mm. 66 inches	.1875¢	.3025¢
12	35mm. 38 inches	.08¢	.16¢
14	16mm. 65 inches	.12¢	.30¢
21	16mm. 29 inches	.055¢	.125¢
28	16mm. 16 inches	.03¢	.0675¢

resort to low processing costs may entail a low reduction ratio, and hence the saving in processing may be sacrificed by increasing the material cost.

Just as in calculating typescript book costs it was necessary to assume arbitrarily an average typing charge before proceeding to further comparative studies, so in calculating microcopying costs an arbitrary average processing figure will be assumed. The difference between the price of developing a negative and the price of making a positive print from a negative will be ignored; it does not appear in most quotations. Processing will be figured regularly at $.0175 for 16mm., $.025 for 35mm. film; the joint cost of film and processing will stand then at $.025 for 16mm., $.04 for 35mm. film. It is understood that these prices are available only in large footages, running into the thousands of feet. Maximum figures for shorter runs, when necessary, will be assumed at $.03 for 16mm. film, $.05 for 35mm., to include film and processing. Very short runs of a few inches only introduce a special problem which will be separately analyzed.

First Costs and Running Costs in Microcopying

The application of microcopying to the distribution of reading matter is so new, the price levels at which it operates so revolutionary, that the fundamental elements of cost as they appear in publishing are not apparent at first glance, and yet they are present. In microcopying, as in other techniques, there is the antithesis between a cost curve that falls with each additional number of copies and a cost curve that remains constant regardless of the number of copies that are made. In other words, there is a first cost and a running cost. The first cost includes the labor of making a photograph and processing the negative film; the running cost is the cost of making each additional positive from the negative.

There may arise many situations in which there will be no positives made from the negative. The original negative will be made as a unique copy for a single purchaser. The cost of this unique copy will consist of two elements: first, labor in photography; second, film and processing. This situation will be studied first, and then its implications traced in those cases where a number of positive copies are to be made from a single negative for a number of purchasers. The cost of making this negative stands, however, as a "first cost," comparable, for instance, with the cost of setting type and fitting it in a press, or preparing mimeograph stencils or photo-offset metal sheets. It is absolutely independent of the number of copies that are to be made from the negative.

How is this cost to be estimated in the case of long runs of material? As in so many other situations, the most expensive and specialized apparatus reduces the labor cost. The small, non-specialized cameras such as the Leica or Contax correspond to hand-set type in printing, and the large, highly-specialized cameras, such as the Recordak, Filmograph, Kennedy, and perhaps the new Graflex, correspond to the linotype in efficiency.

Experience in photographing large collections of documents has been most amply obtained by the Filmograph Corporation and by Lloyd B. Kennedy in copying land title abstract records, and by the Recordak Corporation in a variety of copying enterprises.

Filmograph and Kennedy experiences agree in establishing that one operator can copy 10,000 pages of bound records per day; Dr. T. R. Schellenberg, using a Recordak to copy the unbound typescript pages of the NRA and AAA hearings, also copied 10,000 pages a day. In all these cases there was material in hundreds of thousands of pages, uniform in size, continuous in supply. The May Company of Cleveland uses a Recordak to copy its internal records. The operators photograph 20,000 statements, 7" x 10", per day. Speed records with the new Recordak bound book copying camera are not available. It is safe to conclude that experience with uniform and continuous matter, whether bound or unbound, permits an estimate of 10,000 pages a day as a maximum.

While these automatic machines can be operated by relatively unskilled labor, it is not too much to count the labor cost at $10.00 per day, which might cover the wages of two operators, one to do the photographing, the other to bring the material to the machine and return it to place.

This labor cost is independent of

the reduction ratio and hence of the amount of film used in a given copying job. But with the film used at a reduction ratio of 16 to 23 diameters, and processing costs figured at their average for long runs, the cost of film and processing should stand somewhere near the labor cost--perhaps $10.00 worth of labor will photograph $12.00 to $15.00 worth of film (including processing). At this rate the first cost --i.e., the finished negative--of microcopied material in large runs can be made for $.22 to $.25 per 100 pages. This is the cost at which a unique copy of a great body of material could be made for a single purchaser.

But if a number of purchasers should wish to acquire the same material, the cost of making the positive copies for each would be exactly the film-and-processing charge for film plus a pro-rata fraction of the first cost divided among the purchasers. The behavior of costs in this situation can be illustrated from two cases: first, the actual experience of the Joint Committee on Materials for Research in distributing microcopies of the hearings held under the NRA and AAA; and second, the estimated costs of a project for copying two million pages of books printed in England before 1640--a project that would bring to subscribing libraries copies of all books listed in Pollard and Redgrave Short Title Catalogue.

The Joint Committee arranged with the Agricultural Adjustment Administration and the National Recovery Administration to make microcopies of the hearings. The total number of typescript pages was approximately 315,000. The reduction ratio was 23 diameters. The cost of making the negative, including Recordak rental, film and film developing was $455.00 for 13,400 feet of 16mm. film. The cost of making additional positives was $368.50 each. The whole project was figured to distribute the cost of making the negative among ten subscribers, making the cost of the microcopies of the 315,000 pages $413.50 or $.13 per 100 pages.

The work of microcopying this great body of material was carried to a successful conclusion by Dr. T. R. Schellenberg, in spite of many obstacles. The material consisted of unbound typescript pages, some of them carbon copies on thin paper, together with a number of printed pamphlets. When the material was first filmed, the operative employed to feed the pages skipped some of them or fed them into the Recordak machine in an irregular way. Moreover, the machine itself was not set to take care of the photographic differences between light and dark copies, or between bond and onionskin paper. When a check up of the first film copy of the NRA records revealed imperfections, an effort was made to correct them by cutting the microcopy strips and interspersing freshly photographed strips of film in the faulty places. But this film strip, when used for making positive copies, did not prove satisfactory. Dr. Schellenberg therefore recopied the whole file of NRA hearings, with the technical help of members of the staff of the Recordak Corporation, which was very generous, not only in solving technical difficulties, but also in contributing free of charge the machine and film for the second copying. In calculating and assessing the cost of the project, the extra copying operation was not taken into account, for it was the result of conditions which need not be duplicated in the future, and is charged off to experiment and experience.

A project to make widely available copies of all early printed English books has been under discussion among librarians for several years, and has led to a number of cost calculations. The project differs from that of copying the AAA and NRA hearings, not only in its greater magnitude, but also in the greater expense that must necessarily be incurred in travel and supervision, and in setting and resetting the camera to take volumes of different sizes at different reduction ratios. A memorandum on cost was drawn up at the office of the Joint Committee in September, 1935. For purposes of calculation it was assumed that the total number of pages would be two million, and the average page size an octavo in twelve-point type. The calculation was made to cover two alternatives in reduction ratio--12 diameters and 21 diameters, and the alternative of using 35mm. or 16mm. film. The memorandum on cost, while rather elaborate, serves to illustrate the behavior of so many of the variables in microcopying that it is here quoted textually:

The first cost of making an original

negative of the estimated two million pages is hard to calculate and not greatly dependent on reduction ratio, for so much of it will be travel, supervision, apparatus and labor of incalculable efficiency. These costs, exclusive of film cost, could be calculated for two million pages as follows:

Labor cost	$8,000.00
Fare, supervision ..	6,000.00
Miscellaneous	2,000.00
Indexing	2,000.00
Total	$18,000.00

Other costs are variable with the number of feet of film used. On 35mm. film in the third position, reduced 12 diameters, 2,000,000 pages (750,000 linear feet of book) would go on approximately 62,500 feet of film plus 10% for margin, bringing the total roughly to 70,000 feet. On 16mm. film in second position, reduced 21 diameters, 2,000,000 pages (1,000,000 feet of book) would go on 48,000 feet of film plus 10% for margin, bringing the total to 53,000 feet. The cost for the film and the processing for 35mm. film, if figured at $.04 a foot, is $2,800; for the 16mm. film, figured at $.025 a foot, it is $1,325.

Resuming our calculations, the difference in reduction ratio and film cost becomes increasingly important as the number of subscribing libraries increases. The possibility will also appear that very substantial reductions in the processing cost of the film may become available if the footage runs high enough. However, maintaining the constant calculation of $.025 for the 16mm., $.04 for the 35mm. film the costs for subscribing libraries would stand as follows:

10 libraries ....$4,880 at 12 diameters, 35mm. film; or $.24 per 100 pages
$3,257.50 at 21 diameters, 16mm. film; $.165 per 100 pages
20 libraries ... $3,840 at 12 diameters, 35mm. film; or $.20 per 100 pages
$2,292 at 21 diameters, 16mm. film; or $.115 per 100 pages
40 libraries ... $3,320 at 12 diameters, 35mm. film; or $.17 per 100 pages
$1,808 at 21 diameters, 16mm. film; or $.09 per 100 pages

By the time forty libraries are reached, the cost of film and processing has become dominant and any economies in these costs would be felt immediately.

The effect of differences in processing costs when the number of subscribers reaches 40 is shown by recalculating the costs at maximum and minimum processing figures($.055 maximum and $.025 minimum for 35mm. film; $.05 maximum and $.0225 minimum for 16mm. film).

40 libraries ... $1,750 at 12 diameters, 35mm. film; or $.09 per 100 pages (film and processing at $.025 per foot)
$4,397 at 12 diameters, 35mm. film; or $.22 per 100 pages (film and processing at $.055 per foot)
(Difference of $647 between high and low processing)
$1,672.32 at 21 diameters, 16mm. film; or $.085 per 100 pages (film and processing at $.0225 per foot)
$3,167 at 21 diameters, 16mm. film; or $.16 per 100 pages (film and processing at $.05 per foot)
(Difference of $1,494.68 between high and low processing)

Microcopying "Reprint Costs"

Microcopying, like book production, as has been stated, gives rise to both "first cost" and "running cost." The first cost in microcopying is compounded of two factors, the first of which is largely labor, and is dependent upon the number of pages copied, regardless of the area of film used; the second is film and processing, and is dependent upon the area of film used, regardless of the number of pages copied upon it. The labor cost of photographing is roughly analogous to the composition cost of book manufacture; it varies with the number of pages rather than the number of words. The running cost (that is to say, the cost that depends upon the number of copies) is simply the area cost of the first copy, multiplied by the size of edition.

Another kind of cost is present in book manufacturing, the "reprint cost." This is the "first cost" of bringing out a second edition. The reprint cost is less than the first cost of the first edition of a book provided plates are made from the type, or the photo-offset metal sheets preserved for a second run. But the reprint cost in book manufacture, regardless of these economies, is always substantial. In microcopying large footages the reprint cost is nil. No special expense is incurred in production if, when 10,000 feet of film have been distributed to each of ten subscribing libraries, an eleventh library comes along a year later and asks to have an eleventh copy made for it. The cost of making the eleventh copy is simply the normal film-and-processing cost. For this reason microcopying offers remarkable elasticity in the distribution of material. There need never be an "overprint," made at the risk that no one will wish to buy it. This quality of microcopying, it must be remembered, is present only to the degree that the footage involved in a single order is large enough to obtain low processing prices.

Short Footages in Unique Copies

An application of microcopying that is already developing, and promises to have great utility in the future, is the making of microcopy negatives of books or periodical articles upon the order of individual purchasers, whether research workers or libraries. The installation of efficient photographic equipment may make it possible for a large library to make its resources generally available to readers anywhere at the price level of microcopying.

If the number of pages to be copied per day in a library should be large enough to allow the continuous operation of the machine, the operating cost would rise above that of a long run of uniform material only to the extent that readjustments of focus became necessary in changing from books of one page size to books of another size. The processing costs could still stand at the level of long run work. An additional charge would be incurred in cutting up the strips and mailing the short lengths to the various purchasers, but this type of service, in the experience of the Recordak Corporation (which cuts up long strips of bank records and mails them to individual banks) would not lift the costs to an entirely new level. Bookkeeping costs would appear, but it seems quite probable that on large-scale work the price level could be held down within striking distance of the price of long-footage orders.

Microcopying and Long-Distance Use of Libraries: the "Bibliofilm Service"

The most interesting effort to develop a service of this kind has been made by Mr. Atherton Seidell, Dr. R. H. Draeger of the U. S. Navy Department and Miss Claribel Barnett, librarian of the Department of Agriculture Library, Washington, D. C. In November 1934, Miss Barnett established the "Bibliofilm Service" in the Library of the Department of Agriculture. The date is an important one in the history of microcopying applications.

Miss Barnett has described the administrative routine of the Bibliofilm Service in an article in The Camera vol. L, no. 5, May 1935, pp. 327-328, as follows:

> The procedure begins "with the suppliance of a 3" x 5" slip or card specifying the article desired--one such slip for each and every article, and each slip carrying the name and address of the customer. The slips are returned with the finished films. Attendants take the slips, search the library, send the books to the photographing room, there each article is copied on a continuous strip of film, leaving spaces between for cutting. When all the day's orders are photographed, the film will be developed, fixed, washed and dried, then cut up and each sequence attached to its proper slip and mailed to the customer or delivered by hand as it may be. Prepayment for the service is urged when possible, this to save accounting, etc., and a deposit of funds which may be drawn upon is possible.

The film copies or "filmstats" as they are called are priced at $.10 for each article not exceeding ten pages, and $.05 for each additional ten pages. The increasing use of the Bibliofilm Service is evident from a report in Agricultural Library Notes for June, 1935; the number of pages copied per month rose from 470 in November 1934, to 6,597 in May 1935.

Miss Barnett writes that the rates during this experimental period have not covered the cost of keeping the records and correspondence, but that the clerical cost may be materially lessened after the procedure has been better established. Moreover, the clerical costs as they stand are not greater, she believes, than those connected with the lending of books, for such costs as charging and discharging loans, or following up loaned volumes by correspondence to secure their return, are avoided. Studies of the cost of interlibrary loans made by the University of California--though challenged by some librarians--set the cost of each loan at well over a dollar, and offer strong confirmation to the views of Miss Barnett. Scholarship stands much indebted to her for the well-conceived initiative.

Other libraries have installed equipment for making microcopies, but the cameras used do not have the efficiency of the Draeger camera used by the Department of Agriculture Library. The price for microcopies at the Library of Congress, the New York Public Library, and Yale University Library is set at $3.00 per 100 exposures; at two pages per exposure, this amounts to $1.50 per 100 pages. Huntington Library at San Marino, one of the first to install equipment, charges $5.00 per 100 exposures, or $2.50 per 100 pages. A large microcopying machine has been installed in the Preussische Staatsbibliothek, but no quotations on service have been received by the Joint Committee.

Since installation of equipment in America has already reached three of the largest libraries in the country, it is safe to say that at this very moment microcopies of several million volumes of books and periodicals are already available to research workers at a price ($1.50 per 100 pages) not much in excess of the normal price paid for books. Since the Wilson Union List of Periodicals in American Libraries will inform any reader anywhere whether a given volume of a periodical is available at one or another of the libraries offering this service, scholars are now able to arrange with speed and certainty to have copied for them periodical articles not accessible in their own institutions.

Microcopying and Copyright

While these innovations have offered a mechanical means of increasing the working power of scholars throughout the country, it has been necessary to prepare the legal ground for their use. For most of the learned journals from which scholars are likely to seek microcopies are covered by copyright. With books it is otherwise; most of the rare and inaccessible books are probably the old books, on which copyright has expired. But the whole question of photographic copying in its relation to copyright has been full of uncertainties.

Discussion with specialists in copyright problems showed that the law has been highly elaborated in court decisions to define the limits of so-called "fair use" when copyright material is republished for profit, but that no court decisions apply to the situation of the research worker who copies out notes from a copyrighted work in the course of his research. The letter of the statute would seem to indicate that the scholar with a fountain pen copying paragraphs out of an article in a learned journal was engaged in technical violation of the copyright statute, but it seemed evident that the courts would necessarily make a distinction between the kind of copying that is done in the course of research, when the copied matter merely enters a scholar's note file, and the reprinting of material for sale or distribution. The librarians had felt for some time that the uncertainties of the law hampered them in some measure in laying down policies in the use of the photostat, and it was clear that the extension of microcopying, because of the lower price level, would increase the problem.

When the text of the new copyright law was under discussion in Washington in the spring of 1935, the suggestion was made that specific reference in the law should cover photographic copying for scholarly purposes; but the legal advisers of the publishers, while quite willing to have the photographic copying devices used to help scholars in research, felt that such a provision of the law would necessarily be so complex that it might either defeat its own purpose or undermine the whole structure of copyright.

The whole subject was explored in a generous and sympathetic spirit at a meeting of librarians and book publishers. Mr. H. M. Lydenberg of the New York Public

Library, Mr. Milton Ferguson, chairman of the book-buying committee of the American Library Association, and Dr. Andrew Keogh of Yale University Library met with Mr. Frederic Melcher, chairman of the copyright committee, and the board of directors of the National Association of Book Publishers. As a result of correspondence and conference to which a number of librarians contributed, a "gentlemen's agreement" on photographic copying for research purposes was drawn up and signed by Mr. W. W. Norton on behalf of the National Association of Book Publishers and by Dr. Robert C. Binkley on behalf of the Joint Committee on Materials for Research.

The main principles of the agreement are, first, that photographic copies of parts of books or periodical volumes may be made by a library and delivered without profit to a purchaser in lieu of loan or manual transcription. The paragraph was phrased to apply to the copying of a complete article from a periodical volume, but it would not apply to the microcopying of a whole volume or file of a periodical. The second principle is that the photographic copy is not to be a substitute for the purchase of the material; it can be taken for granted that the known practices of research scholars in the collecting of material for research will guide the intelligent application of this principle. The third principle is that the library which carries out the above principles in good faith is not to be held liable for violation of copyright law, but that responsibility for any possible infringement shall rest with the purchaser of the photographic copy. Subsequent correspondence has shown that some photographic copying problems arising in libraries are not explicitly covered by the agreement, but the main principles are sufficiently clear to justify the development of microcopying services in lieu of inter-library loans.

The text of the agreement is reproduced herewith:

Correspondence and Agreement on the Photographic Copying by Libraries of Copyrighted Material

May 25, 1935

Mr. W. W. Norton, President
National Association of Book Publishers
347 Fifth Avenue
New York, New York

Dear Sir:

On behalf of the Joint Committee on Materials for Research, I write to thank you for the consideration your organization has given to the increasing importance of the problem of conscientious observance of copyright that faces research libraries in connection with the growing use of photographic methods of reproduction. Not so long ago the scholar or student contented himself with pencil or ink transcripts of passages in the books and periodicals he consulted in connection with his studies. The increased use, first of the fountain pen, then of the standard typewriter, then of the portable typewriter, developed a corresponding increase in the number and amount of transcripts made for this same purpose. Within the past few years, the use of photography, the photostat, and now the 16 or 35 millimeter film cameras have added to the amount, the extent, the speed--and the problems--of this reproduction.

We realize, of course, that we can speak only on behalf of the publishers, libraries and research workers of this country. The problem is of importance also in connection with foreign copyrighted books, particularly the publications of academies or learned societies and the unofficial periodical press printing the results of research. As to such books and periodicals, the foreign publisher or copyright owner is the final authority. We feel, however, that the common interests of both groups would make it fair for us to assume that the practice approved by American publishers and libraries would satisfy their brothers in other countries.

We are told that from time to time instructors in various schools and colleges have reproduced in one way or another extensive portions or whole chapters from copyrighted textbooks, which have been sold or given to their classes as substitutes for the textbooks. We see how keen an injustice and how severe a harm is done to the owner of the copyright by such practices, and we participate with you in the condemnation of such obvious violations of copyright.

The indication you have given of what publishers and authors, as owners of copyright, can suggest to archives offices and museums as a guide to a code of fair practice in connection with the commendable form of public service rendered by photographic methods of reproduction is so clarifying that we suggest it be put in the form of an agreement and published.

Very sincerely yours,

(signed) Robert C. Binkley
Chairman, The Joint
Committee on Materials
for Research

- - - - -

May 27, 1935

Dr. Robert C. Binkley, Chairman
Joint Committee on Materials for Research
Western Reserve University
Cleveland, Ohio

Dear Dr. Binkley:

We deeply appreciate your desire to work out a code of fair practice which will protect the rights of authors and research workers. As publishers we naturally do not wish to impose restrictions which might hamper students in collecting research material, but on the other hand it is necessary for us all to face this problem realistically and not permit the rapid extension of photocopying to lead to a disregard of the fundamental principles of copyright.

The results of the conference in our office, attended by Mr. Lydenberg, Mr. Ferguson, and Dr. Keogh and members of our committee, have been discussed with Mr. Frederic Melcher, Chairman of the Association Copyright Committee, and by our Board of Directors. We are happy to have the results of these conferences put in the form of an agreement and published with this correspondence.

Very sincerely yours,

(signed) W. W. Norton, President
National Association of
Book Publishers

The Joint Committee on Materials for Research and the Board of Directors of the National Association of Book Publishers, after conferring on the problem of conscientious observance of copyright that faces research libraries in connection with the growing use of photographic methods of reproduction, have agreed upon the following statement:

> A library, archives office, museum, or similar institution owning books or periodical volumes in which copyright still subsists may make and deliver a single photographic reproduction or reduction of a part thereof to a scholar representing in writing that he desires such reproduction in lieu of loan of such publication or in place of manual transcription and solely for the purposes of research; provided
>
> (1) That the person receiving it is given due notice in writing that he is not exempt from liability to the copyright proprietor for any infringement of copyright by misuse of the reproduction constituting an infringement under the copyright law;
>
> (2) That such reproduction is made and furnished without profit to itself by the institution making it.
>
> The exemption from liability of the library, archives office or museum herein provided for shall extend to every officer, agent or employee of such institution in the making and delivery of such reproduction when acting within the scope of his authority of employment. This exemption for the institution itself carries with it a responsibility to see that library employees caution patrons against the misuse of copyright material reproduced photographically.

Under the law of copyright, authors or their agents are assured of "the exclusive right to print, reprint, publish, copy and vend the copyrighted work," all or any part. This means that legally no individual or institution can reproduce by photography or photomechanical means, mimeograph or other methods of reproduction a page or any part of a book without the written permission of the owner of the copyright. Society, by law, grants this exclusive right for a term of years in the belief that such exclusive control of creative work is necessary to encourage authorship and scholarship.

While the right of quotation without permission is not provided in law, the courts have recognized the right to a "fair use" of book quotations, the length of a "fair" quotation being dependent upon the type of work quoted from and the "fairness" to the author's interest. Extensive quotation is obviously inimical to the author's interest.

The statutes make no specific provision for a right of a research worker to make copies by hand or by typescript for his research notes, but a student has always been free to "copy" by hand; and mechanical reproductions from copyright material are presumably intended to take the place of hand transcriptions, and to be governed by the same principles governing hand transcription.

In order to guard against any possible infringement of copyright, however, libraries, archives offices and museums should require each applicant for photomechanical reproductions of material to assume full responsibility for such copying, and by his signature to a form printed for the purpose assure the institution that the duplicate being made for him is for his personal use only and is to relieve him of the task of transcription. The form should clearly indicate to the applicant that he is obligated under the law not to use the material thus copied from books for any further reproduction without the express permission of the copyright owner.

It would not be fair to the author or publisher to make possible the substitution of the photostats for the purchase of a copy of the book itself either for an individual library or for any permanent collection in a public or research library. Orders for photocopying which, by reason of their extensiveness or for any other reasons, violate this principle should not be accepted. In case of doubt as to whether the excerpt requested complies with this condition, the safe thing to do is to defer action until the owner of the copyright has approved the reproduction.

Out-of-print books should likewise be reproduced only with permission, even if this reproduction is solely for the use of the institution making it and not for sale.

(signed) Robert C. Binkley, Chairman
Joint Committee on Materials
for Research

W. W. Norton, President
National Association of Book
Publishers

"Publishing" Short Runs of Material by Microcopying

One of the most intricate, and at the same time the most important, of the problems encountered in the use of microcopying is its possible substitution for publication.

In its simplest form, such a substitution for publication would take place automatically if a library which offers microcopying service has in its possession unpublished material, and the probable purchasers of such material are aware of its existence and availability through the usual bibliographical guides. For instance, if a typescript copy of a monograph should be deposited in the Library of the Department of Agriculture, and listed or given notice in the learned journals, the Public Affairs Information Service, and other bibliographical guides, it would be, in effect, "published" to the degree that scholars would be willing to buy and use microcopies of it.

But in such a case each individual purchaser would require that the book be photographed anew. A new negative would be produced for each "sale" of the book.

Would it be possible to organize the distribution of microcopies of such a work in a way that would take advantage of the labor-saving that can occur when a number of positives are made from a single negative? Of course, if the material in question fills a large enough film footage, the additional copies after the first negative are available with present technique at a price lower than the cost of the first negative. But in the case of a short strip of film--a few inches or a few feet--there is at present no way of taking advantage of the theoretically low cost of making a number of prints from a single negative in the production of positive prints to order. What is the amount and behavior of such anticipated economies? What is the difference between the cost of making a negative microcopy from a book and the cost of making a positive from a negative? And what is the cost of maintaining a catalogue, and shelving or storage system for film negatives?

It has been shown that, for long footages, the cost of making a positive from a negative is not greater than the processing cost of the same footage of negative. Even short items can be produced as negatives at the low processing cost of the long footage, because a large number of items are copied on a long roll, and the roll subsequently cut up. But if positive copies are to be made from the short scraps of negative, the processing cost rises. Short scraps of negative give rise to high costs in making positive copies. But the cataloguing and storage expenses for short pieces are as high, per item, as for long strips. Consequently for short items it will be wasteful to save the negative, for long items wasteful not to save it. The dividing line is probably the 100-foot reel, which may mean a unit of 2,000 pages.

For the shorter items--and this means for most scientific literature--present apparatus will not justify the expense of holding a negative for the sake of making a number of positives from it. But if a large number of microcopies of a scientific article are to be made from the same paper copy, the paper itself may wear out in the repeated photographing. "Publication" by microcopy methods would put upon a book the same amount of wear that would take place if every reader used the same copy. Librarians who have administered "reserve book rooms" for large university classes know how quickly a book will wear out under constant use.

This is the problem to which Dr. Watson Davis of Science Service has devoted a vast amount of intensive thought and planning. The solution suggested by him is an important contribution to the use of microcopying, and to the organization of the distribution of scientific literature. He proposes that the negative made from an original typescript, or indeed a negative made from a published article or book, should take the form, not of a length of film strip but of a rectangle of film, suitable for filing in a card catalogue. It is deemed technically possible to put 150 pages of microcopied material on a 3" x 5" card (a 70mm. film cut into 5" strips would measure 2 3/4" x 5"). Even if the number of pages that can be copied on such a card is materially less than 150 pages, the essential value of his suggestion lies in its answer to two of the most difficult problems in microcopying short items. For a short strip of roll film is not easy to store, it must be placed in a small compartment or container, the container labelled, and then the collection of containers and films controlled by a catalogue. If the film copy of the article or book can become itself the catalogue card, the problem of cataloguing and storing disappears. This is the first advantage of his plan. The second advantage appears in connection with processing. To make a positive print from a short strip of motion picture film is more difficult than to make a print from a single rectangle of film. His plan should tend to make "reprint costs" for short items behave as if the items were long, and at the same time eliminate a heavy cataloguing and storing charge.

It has been suggested by several writers that the future may see whole libraries copied on film, and the negatives stored in such a way that positive copies from any of them can be run off on demand. It is sometimes thought that when a library, in responding to a demand for a microcopy of an item, makes a negative copy, it should make a positive from the negative, send the positive to the purchaser, and retain the negative to make positives for other purchasers. This is the procedure that the technique of photography suggests as normal. But how does it fit into the practical administration of library resources?

In the analysis of library costs, it was established that cataloguing and shelving of books are items of library expense that approach in magnitude, or even pass, the cost of the books themselves. Microcopying in lieu of inter-library lending, when organized like the U. S. Department of Agriculture Bibliofilm Service, imposes no extra cataloguing charges on the library. The film service simply uses the existing catalogue and shelving system. If an effort is to be made to use a negative more than once, the library must control its negatives by means of a catalogue system that will parallel its book catalogue, growing with the growth of the collection of negative films. This extra cost can be made up only if it results in substantial economies.

Dr. Davis has received from the Chemical Foundation a grant which he will use to develop the apparatus necessary to put his plan into effect. When the apparatus is ready, the day will have arrived when microcopying is technically suited to do for the intellectual world what publishing has hitherto done, with immeasurably greater elasticity and at a fraction of the cost. The long roll of film will probably remain as the best medium for the microcopying of long items, because it will do for the microcopies what binding does for a book--keep the series in its fixed order. The card negative will serve for the short items, arranged in an open order, with new items placed between items already in the file.

The Problem of Standardization of Equipment and Reduction Ratio

A memorandum by Mr. Verneur E. Pratt

of the International Filmbook Corporation, and a series of letters and memoranda by Dr. Watson Davis, call attention to the vital importance of standardization in the development of apparatus for microcopying. Mr. Pratt writes:

> If certain rumors and actual reports are to be considered authentic, there is an alarming disparity in the use of films. Some are planning microcopies to be made on 16mm. film; others upon 35mm. film, still others upon widths not usually considered standard. The minifications vary from 12 to 24. Some projectors and cameras now being designed and readied for the market are adopting 35mm. film with the customary double row of sprocket holes. Others, with a view of salvaging more of the available area, are planning on the use of film on which but one row of sprocket holes is punched. A camera concern is developing a reading machine which uses no sprocket holes ....
>
> Furthermore, there is as yet no standardization of titling, of separation of dockets, folios or pages. There is no uniformity of treatment in locating pages on the film--some photographing newspaper pages vertically but book pages horizontally. Some are ignoring frame lines and others attempting to squeeze a certain number of pages into the definite standard film size.
>
> Unless this situation is immediately controlled through action of a standardization committee, this lack of uniformity is going to cost millions of dollars to correct. In the early days of electric lamps each manufacturer brought out his own specifications of the base. The result was that electric lamps had to be especially made to fit each manufacturer's sockets. No one has been able to calculate the millions which this foolish lack of standardization cost.

The problem of standardization brings to the fore the important fact that microcopying involves not only the manufacture of the copies themselves, but also the distribution of reading equipment. The cheaper the reading equipment, the more easily will it be distributed to a number of scholars sufficient to render practical the large-scale utilization of microcopying in research. But at the same time, the reduction in the price of reading equipment means an increase in the cost of microcopies, because reading machines that will handle the high reduction ratios that go with low-cost micro-films will be more expensive than reading machines that handle only low reduction ratios. The manufacturing cost of reading equipment increases with the reduction ratio of the microcopy it is prepared to handle, and with the area of reading matter laid before the reader at a time. The *magnifying power*, *field of vision*, and the *light intensity* (which determines the amount of contrast in the projected image) are the three optical elements of the reading equipment which seem to have the controlling position in the determination of costs of equipment. There are other important points to be noted in reading equipment, such as ease of loading the film, or ease in passing from one page to another, but these can be ignored for the moment. They are independent of the choice of magnifying power, field of vision and light intensity.

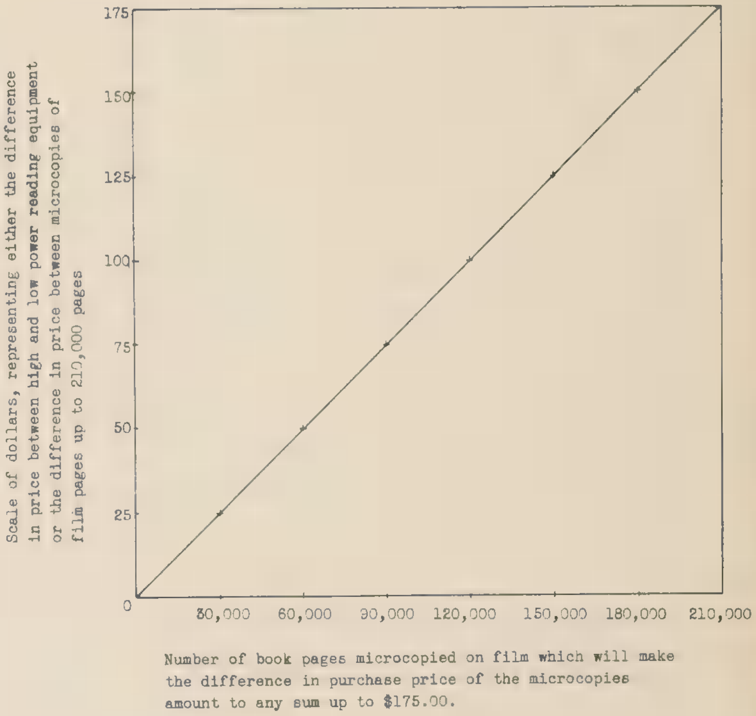
As soon as the cost of reading machines is introduced into the analysis of microcopy costs, the remarkable fact emerges that some of the fundamental elements of publishing accountancy are still present, but with the situations of the publisher and reader reversed. If a reader buys for $100 a reading machine which he uses to read 1,000 pages, he is paying $.10 a page for reading equipment; if he gets 100,000 pages of reading matter, the cost per page of his reading equipment is only 1/10 of a cent. His reading machine is a "first cost," and the footage of film he acquires or uses in it a "running cost." If he cuts this first cost by purchasing a projector that will not handle microcopies of 23 diameters reduction, but will accept only microcopies of 9 or 12 diameters reduction, his running cost of reading matter will rise because he must pay more per page for the microcopies. If he cuts his first cost by contenting himself with a machine that will show only a small area of projected image at a time, or give a lower light intensity, he may retain the low running cost of his reading matter, but must accept a sacrifice in the legibility factor.

The situation may be clarified by an illustration taken from transportation. The railway (like publishing in printed form) imposes a heavy first cost in making every trip. But this cost per passenger will fall with the number of passengers, exactly as the cost per reader of printed books falls with the number of copies sold. The railway company makes the initial investment, the passenger pays only for what he uses, just as the publisher carries the initial cost and risk of publishing, and the book buyer limits his investment to what he can actually use. The system will only be economically justifiable if a large number of people wish to go to the same place at the same time, just as publishing is only economically feasible if the saleable edition is large.

The quantitative relationship between the higher cost of projectors to read film at high reduction ratios and the lower cost of the film itself is easily established from the calculations made above of the cost of microcopying the English books printed before 1640. Basing this calculation on the estimates of the cost to the libraries of film when forty libraries purchase copies, two quantities can be plotted against each other on a graph. On one axis is the cost differential between high power and low power projectors; on the other axis is the cost differential between high reduction and low reduction film. The figures for the film are expressed in thousands of pages, the figures for the projector in dollar differences between alternative reading machine prices. Every 30,000 pages will justify an expenditure of an additional $25.00 for a reading machine.

TABLE XLIV

GRAPH TO SHOW THE AMOUNT OF MICROCOPYING THAT WILL JUSTIFY THE EXPENDITURE OF ANY GIVEN INCREMENT IN THE PRICE OF A READING MACHINE NECESSARY TO READ REDUCTIONS OF 21 DIAMETERS RATHER THAN REDUCTIONS OF 12 DIAMETERS



The passenger has an alternative: he may buy a car. In that case he will have a fixed cost per mile for gas and oil, like the cost per page of books purchased in microcopy form. This cost will be constant, no matter how much he travels. He can go where he will, whether anyone else is going there at the same time or not, just as the microcopy reader can get any item in microcopy form, whether other readers want it or not. He is limited only by the road network, as the reader of microcopies is limited only by the resources of libraries offering microcopying service; and in this respect both car owner and microcopy reader are users of public property. And the microcopy, like the automobile, if used on a large scale, may change the whole design of a compartment of life. But the development of microcopying in lieu of, or as a supplement to, printed book publication, like the development of the automobile in its relation to railway travel, will attain its technological possibilities only to the degree that a wide market cuts the first cost of the reading equipment, the individual owners of it distribute this first cost over a large footage of film, and the libraries offer the services that render both of these conditions possible.

This comparison brings to light at once the tremendous difficulty and the supreme importance of standardization at an early stage in the development of the new devices. Let us imagine, as a kind of a fantasy, that the automobile in its early stages had been some kind of a machine that required for its operation a special kind of road. Then let us suppose that in one part of the country roads were under construction that would serve for one make of automobile, while in another part of the country roads were built for another make of car, with road and automobile so related that the machine built to go on one road would not go on another! That is the kind of problem facing the intellectual world at this moment in the standardization of microcopying. Shall we build a projector that will read any microcopied film, whether card or film strip, whether broad or narrow, whether in a high or low reduction ratio? Conceivably such projectors can be designed, but will not their cost be so high that wide distribution will be forestalled? Or shall we have several makes of projector, each adapted to a particular kind of microcopy film, in which case the utility of each to the reader will be limited even though the price be less. Or shall libraries and others standardize their microcopying in such a way that one simple projector will serve for all purposes, in which case there is a risk that the chosen standard may not be the best, and almost a certainty that if it is well adapted to one type of material (as a long file of newspapers) it will be ill adapted to another type of material (as a short typescript monograph).

There are at present too many unknowns to permit the solution of this intricate equation. But the facts and principles already set forth will serve at least to eliminate some of the unknowns, and to simplify in some measure the problem of standardization.

Essentials of Design for Reading Equipment: (a) Length of Line

Into this labyrinth there are many approaches. The analysis might begin with estimates of buying power of various categories of institutions and readers; with estimates of the number of pages likely to be copied and hence the comparison of the relative importance to be attached to film prices and equipment prices; with a calculation of the probability that the essence of the matter lies in the short items on the one hand, long footages on the other; or with an anticipatory measurement of the proportions which various classes of reading matter, such as newspapers, books, manuscripts, etc., will hold in the corpus of microcopied material. But there is one seemingly trivial dimension which appears to the writer to occupy a crucial position in determining policy, and that is the length of the line of print, typescript or manuscript. This unit, it has been noted, always bears some relation to size of print of type, and also to size of page. Bad typography or writing may make the line too long for the print, but there will always be some limits to the variation. Small type is almost invariably set in shorter lines than large type, and if a large page is to be used with small type, the type appears in the form of columns on the page. The resolving power of a photographic emulsion and process is exhibited in the reproduction of a letter, the labor cost of making an original negative microcopy is a quantity that varies with the number of pages, the processing costs of film vary with footage, but the technological meeting point of microcopying and microreading devices is found in the line of reading matter.

Copying and reading devices are not incompatible though they differ greatly in the way in which they render the size of print or of page. A given piece of film, when put in one projector, may yield an image equivalent to 8-point type, in another projector an image equivalent to 16-point type. The same film might show in one projector a spread of two pages laid before the reader's eye at once, in another projector one page only, and in a third projector only the upper half of a page. These differences would not render the projectors incompatible with each other, nor with the microcopying camera. But if a camera makes a microcopy in such dimensions that the projector will display from it an image that does not show full lines, the two are absolutely incompatible.

Already there have appeared in the development of microcopying apparatus several outstanding examples of this incompatibility. The Recordak newspaper projector projects an image from a full frame of a 16mm. film or from one quarter of the "double frame" of a 35mm. film. A newspaper page, copied on the Eastman Recordak machine, is projected and read, a quarter-page at a time. There is no incompatibility here, for the quarter-page of the newspaper holds several columns, and no lines of reading are broken off in the middle. But the Library of Congress microcopies of manuscripts from foreign archives have been made to the number of over a million pages on 35mm. film, and most of them in the "first position" noted above, i.e., one page to a double frame, with the lines running full across the film. These film copies are incompatible with the Recordak projector. The Carnegie Endowment for International Peace, acting on the advice of the writer, made copies of the Paris Peace Conference papers of Colonel House at the Yale University Library. These were copied in the same position as the Library of Congress documents from foreign archives, and are equally incompatible with the Recordak projector. The NRA hearings were copied on 16mm. film in the same position, i.e., with lines running full across the film, but since the full width of the film is only half the width of the 35mm. film, the Recordak projector will display a full page of the typescript, not cutting any lines.

The present tentative design of a projection apparatus to be made by the International Filmbook Company seems to show that less than the full area of a book page is to be projected. About a dozen lines of print appear on the screen at a time. Then the film is moved to bring the remainder of the page into view. The projector is compatible only with film that has the lines running transversely across the film strip, as in positions 1 and 3--or indeed in the multiple arrangement suggested by Mr. Pratt. (see above.) To conform to this type of reading apparatus, Mr. Pratt recommends

> locating all pages vertically on the film, with the lines of the printed matter at right angles to the length of the film. This will permit of simple projectors without revolving objective lenses and gates."

Another projector designed by the International Filmbook Corporation will permit the reading of lines running in either direction, and will expose a variable film area by substituting lenses and condensers.

The Bibliofilm Service photographers, using the Draeger camera, copy their pages in the second position on 35mm. film. If they should copy in the first position, their film could not be read in a Recordak projector; the copies they are making in the second position cannot be read in the International Filmbook Teledex, but can be read in the International Filmbook Optigraph if the rolls are long enough; if they should copy in the third position their film would be readable in either the Recordak or Filmbook projector.

Essentials of Design for Reading Equipment.
(b) The Page Rectangle

Another given quantity, independent of any choice made by the designers of microcopying or reading equipment, is the general proportions of the normal page of reading matter. Ordinarily the page, whether of typescript, manuscript or print, is a rectangle of which the vertical dimension is greater than the horizontal by a factor of 25% to 50%. 8 1/2" x 11", 6" x 9", and other standard sizes from folio to duodecimo carry these proportions. The proportions are independent of the size of the page, and equally independent of reduction ratio in photographing or enlargement ratio in reading. They are related to length of line, because the line always corresponds to the short side of the page rectangle (except for pages set in more than one column).

Taken in conjunction with two other fixed elements of the problem, namely, (1) the standardization of the width of the film and (2) the advantage of using the full area of the film the page rectangle, the proportions of the page rectangle become important determinants of design. This fact becomes especially noticeable when a fixed frame camera is used for copying.

The ordinary moving picture frame on 35mm. film is a rectangle 1" x 3/4", with the long side across the film; the "double frame" used in the Leica, Contax, and Ludwig cameras exposes an area 1" x 1 3/8", or 1" x 1 1/2", with the short side across the film. Edwards Brothers of Ann Arbor is prepared to furnish microcopies of

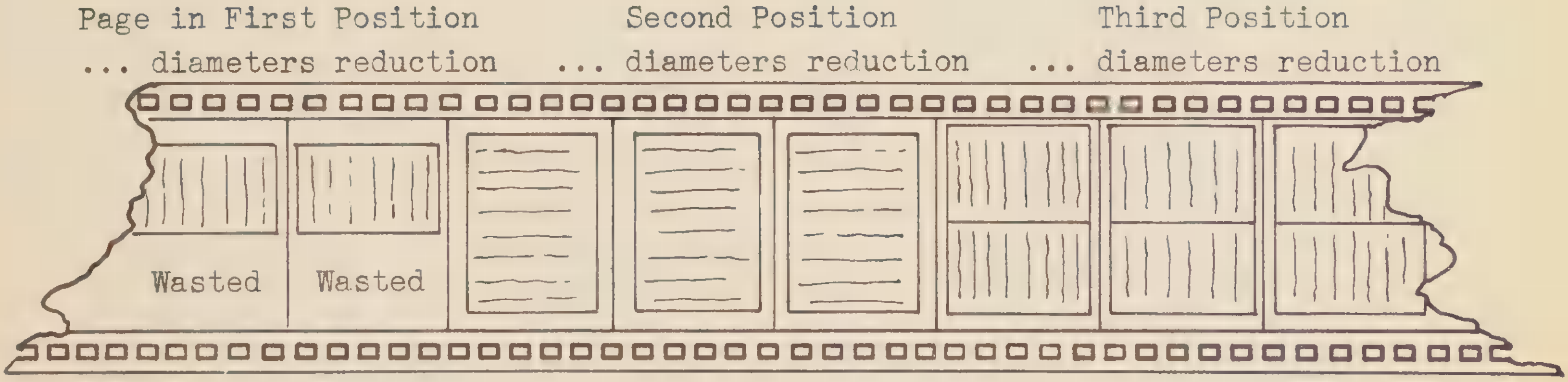
European books made with a single frame camera; the equipment at Yale, New York Public Library, and Huntington Library, is of the double-frame type. With a single-frame camera, pages can be copied in the second or third position without loss of film area; with a double-frame camera pages can be copied in the first and second position without loss. But if a single-frame camera is used to copy pages in the first position, or a double-frame camera to copy them in the third position, from one-third to one-half of the area of the film is wasted.

These considerations do not apply to copying cameras with changeable frames, but so much copying equipment is already set up with fixed frames, and especially with the fixed double frame, that any standardization of projectors that would force users of double-frame cameras to waste from one-third to one-half of their film in order to render their copying compatible with reading equipment would incur disadvantages in distribution. This fact, translated into terms of design, seems to call for projectors that can be adjusted to read lines of print that run across the film as well as lines that run along the film.

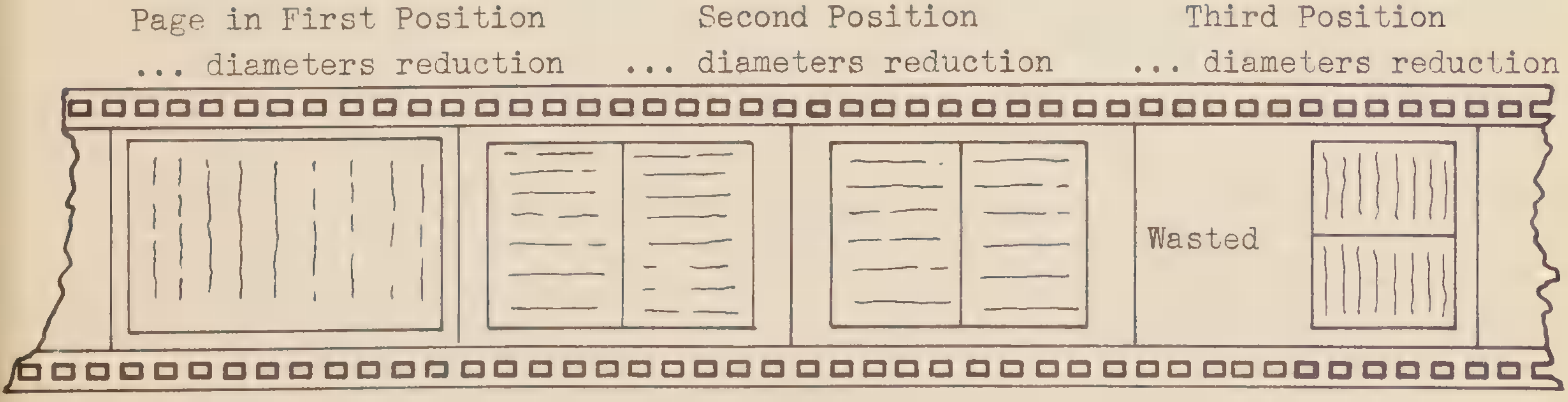
This element of the design of a projector is not a part of the optical system, but of the mechanical structure of the apparatus.

So far as the optical system is concerned, the important fact to notice is that pages always appear as rectangles, of which the short side is the line of print. Two-page rectangles may be photographed on one film rectangle, but the initial proportions of the page rectangle will still control the proportions of the rectangle of film used in copying them. If the camera has a fixed frame area, either single-frame or double-frame, the proportions of the film rectangle are determined by the camera. But even if the camera is adjustable and can expose a larger or smaller length of film at a time, the proportions of the page will still control the proportions of the film

Single Frame 35mm. Film


Page in First Position
... diameters reduction
Second Position
... diameters reduction
Third Position
... diameters reduction
Wasted
Wasted

Double Frame 35mm. Film


Page in First Position
... diameters reduction
Second Position
... diameters reduction
Third Position
... diameters reduction
Wasted

image, which will always be a rectangle with the long side one-third to one-half longer than the short side.

Essentials of Design for Reading Equipment. (c) the Aperture

The aperture of a lens is usually measured as a diameter of the lens circle: but in connection with the problem of projecting pages it must be given another meaning. The aperture dimension that is effective for reading microcopied pages is the length of the long side of a rectangle with the proportions of a page (roughly 1" x 1 1/2"), that can be inscribed in the lens circle. The word "aperture" as used below is a lens area covering a rectangle of film measured along its long side.[4] The aperture thus defined need not correspond in size to the page rectangle on the film, nor to the film rectangle which holds the image of one or two pages, nor the single frame or double frame that has its dimensions set by the camera. But in the ratio of its long side to its short side it will still follow the general proportions of a page. The aperture is to the projector what the frame of film is to the camera.

It is possible to read a large frame of film with a small aperture if the film frame is moved in front of the aperture, so that the different parts are projected successively. This is true whether the frame of film has been used to copy one or two or even more pages. If the long side of an aperture equals the long side of a page rectangle, the page can be read without moving the film; if the long side of the aperture equals the short side of the page rectangle the page can be read by moving the film in front of the aperture; if the long side of the aperture is less than the short side of the page rectangle, the film and projector are incompatible, and the page cannot be read at all, (unless, indeed, the page happens to be set up on columns, and the long side of the aperture is equal to the width of the microcopied column).

To consider an extreme case; two pages can be photographed (in the third position) on a single frame of film. One page of the original print will correspond to half a frame of film. Its long side will be 3/4", its short side 1/2"; the length of line will be 1/2". The aperture required for reading this film need be only 1/2" (1/2" x 3/8") but in reading this film with a 1/2" aperture, the film must be moved successively into four different positions: first, to read the top of the first page; then to read the bottom of the first page; then to read the top of the second page; and finally to read the bottom of the second page. An aperture of 1" (1" x 3/4") would make it possible to read both pages without moving the film; an aperture of 1 1/2" (1 1/2" x 1") would not only permit the reading of both pages at once but would also lay before the reader's eyes, at the same time, two frames of film, with four pages of reading matter.

These principles are used in the Recordak newspaper projector. A newspaper is reduced sixteen diameters on 35mm. film. The aperture of the lens projects from the newspaper page rectangle (1" x 1 1/2") an area roughly 1/2" x 3/4". The film is moved in front of the aperture in such a way that the reader has before him at any time a projection of about a quarter of the newspaper page. Since the newspaper print is set in columns, this arrangement does not violate the principle that the aperture must be sufficient to exhibit the full length of a line. But in the case of the streamer headlines, running full across the newspaper page, this principle is violated, for the reader cannot have before his eye at one time a full streamer headline. This is an admitted inconvenience. It is overlooked in the Recordak design because a very small proportion of the reading matter of a newspaper consists of streamer headlines.

The dimensions of length of line and the proportions of the page rectangle, when considered in connection with the standardized 35mm. and 16mm. film define certain specific dimensions in aperture as fixed alternatives in design.

An aperture 1 1/2" will display the long side of a page rectangle taken on a double frame of 35mm. film. An aperture of 1/2" will display the short side of a page rectangle taken on 16mm. film. The intermediate steps in the series are shown on the chart on the following page.

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[4] If the page rectangle is a multiple of 1" x 1 1/2"--corresponding to the page size 6" x 9", the long side of the aperture rectangle (a) and the diameter of the lens circle (d) will always be so related that d = 1.2 x a. An aperture of 1" goes with a lens diameter of 1.2"; an aperture of 1/2" with a lens diameter of .6", etc.

These dimensions for aperture are final in the sense that there is no reason for building apparatus that will use an aperture intermediate between them. There is no use for an aperture of more than 1 1/2" for 35mm. film; there is no use in making the aperture larger than 3/4" unless it is made a full inch; there is no stopping point between 1/2" and 3/4". An aperture of 5/8" is wasteful; it can accomplish nothing that is not equally well accomplished with an aperture of 1/2". These conclusions follow from the fact that the standard dimensions of the film and the normal proportions of a page rectangle are fixed quantities.

Essentials of Design for Reading Equipment: (d) the Enlargement Ratio

With these apertures accepted as fixed alternatives for reading equipment, it remains not only to decide between them, but also to decide upon an enlargement ratio.

The enlargement ratio has only two fixed points that can be deduced from other fixed elements of the situation. It should hardly be less than six diameters, for then it would overlap the possibilities of direct optical magnifying by reading glass equipment. It is shown above that the cost of photosensitive surface on film is about four times that of the paper surface. If a 6" x 9" page is to be copied in the first position on 35mm. film, with a reduction of 6 diameters, it could be copied at no greater materials cost on paper in a reduction of 3 diameters. The paper copy, legible with a reading glass, would offer marked convenience in storage and filing. Equipment for making such paper copies is in sight. It would seem, therefore, that no enlargements of less than six diameters need be considered. Possibly the same argument in favor of paper could be extended to cover enlargements of eight or even of ten diameters, but for the moment it can be concluded that there is somewhere a minimum enlargement below which projection equipment is unnecessary, and this minimum is certainly six, and possibly 10. diameters.

The upper limit of enlargement is dependent upon the range of the high reduction ratios. If they are set at 16 for newsprint and 24 for typescript, then the reading equipment will follow by disregarding the possibility of enlargement in a higher degree. If the reduction ratio should be pushed up--as some experimenters propose--to 40 diameters for typescript, the projector will have to follow it. These considerations fix the upper and lower limits for enlarging power in reading equipment. Between them there are no fixed stations.

The enlargement ratio is, however, related in an important way to aperture. For instance, to take an extreme case, it is evident that a 1/4" aperture in a machine that would make enlargements of only 10 diameters would have a very restricted use; the octavo book pages or typescript pages that would have their length of line brought down to 1/4" would have to pass through a reduction of 24 or more diameters. The projected image of such a microcopy, if enlarged only 10 diameters, would be less than half the original size and might therefore be illegible. On the other hand, a machine with a 1 1/2" aperture set to make enlargements of 20 diameters, while it would be useful in projecting a full newspaper page at once, would be wasteful in projecting microcopied books that had passed through a reduction ratio of 20 because it would show more pages than necessary, and would be equally wasteful in projecting book pages that had been enlarged only 10 diameters, because it would raise the size of the print to poster size.

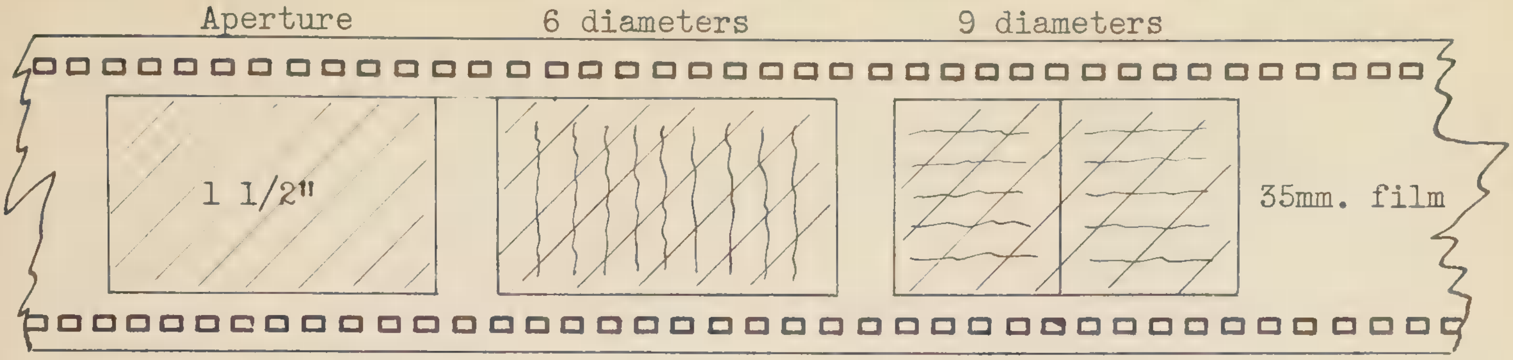
There is another and equally significant relationship between aperture and enlargement ratio. The cost of a lens and condenser system increases with the enlargement ratio, but diminishes with the aperture. Thus an optical system with large aperture and low enlargement ratio will cost the same as an optical system with small aperture and high enlargement ratio. If the present design of a certain reading equipment renders it too costly, the cost can be reduced by redesigning it either for smaller aperture or for lower enlarging power. If reading equipment at present available has insufficient enlarging power, the design can be altered to give a higher enlarging power without altering the cost, but only by diminishing the aperture.

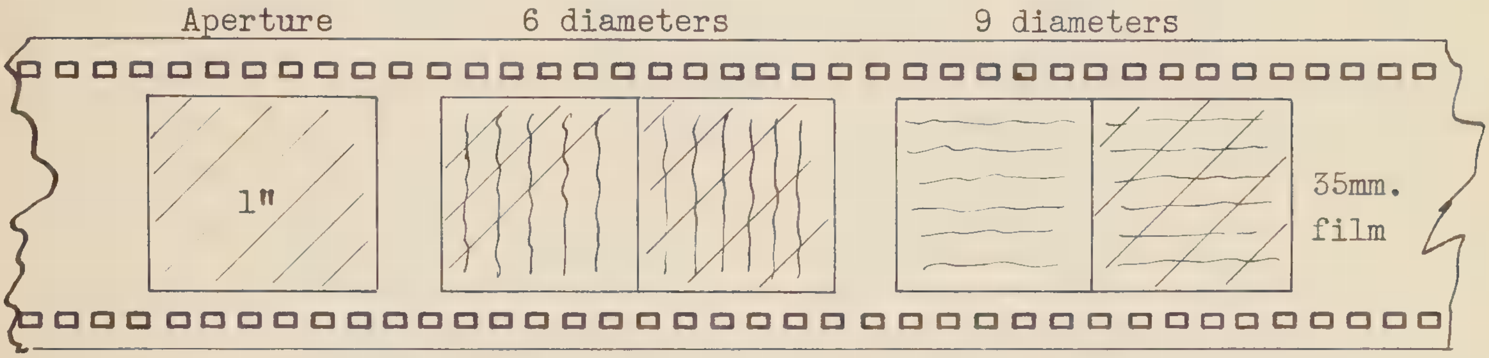
It might be argued that enlargement

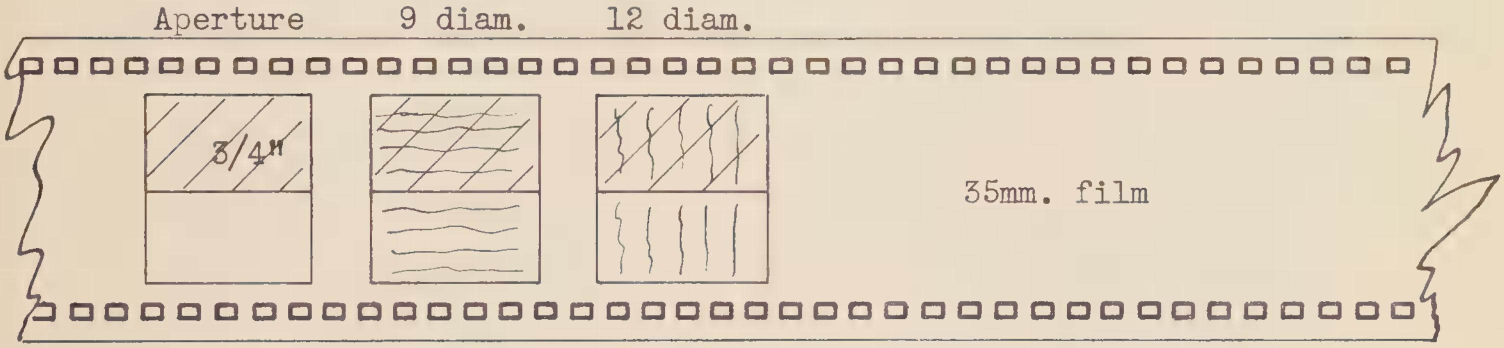
TABLE XLV
CHART OF APERTURE AND CORRESPONDENCE TO FRAME OF FILM

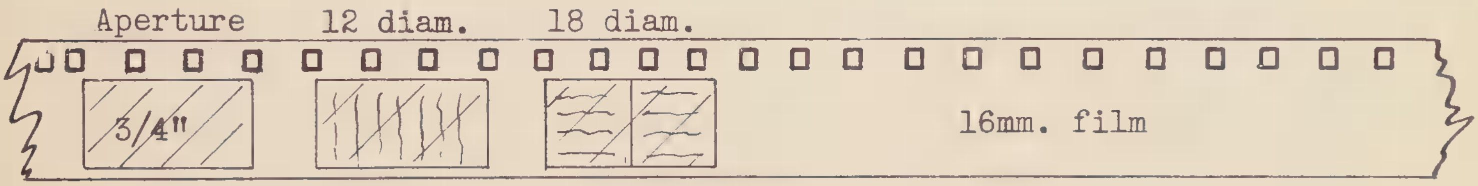
Aperture in Inches	Film Width in mm.	Correspondence of Aperture to Frame of Film, or to Page Rectangle on Film	Reduction Ratio when 6" x 9" Page is Copied for Reading with this Aperture
1 1/2"	35mm.	Long side double frame	6 diameters reduction to read one page; 9 to read two pages at a time
1"	35mm.	Short side double frame, or long side single frame	9 without moving film to read page; 6 if film is moved for reading
3/4"	35mm.	Short side of single frame	9 if film is moved for reading page; 12 without moving film for a page
3/4"	16mm.	Long side of double frame	12 without moving film; 18 to show two pages at a time
1/2"	16mm.	Short side of double frame	12 if film is moved; 18 without moving film
3/8"	16mm.	Short side of single frame (page copied in second or third position)	18 if film is moved; 24 without moving film
1/4"	16mm.	One-half of short side of single frame (pages copied in third position)	24; film must be moved for reading the page

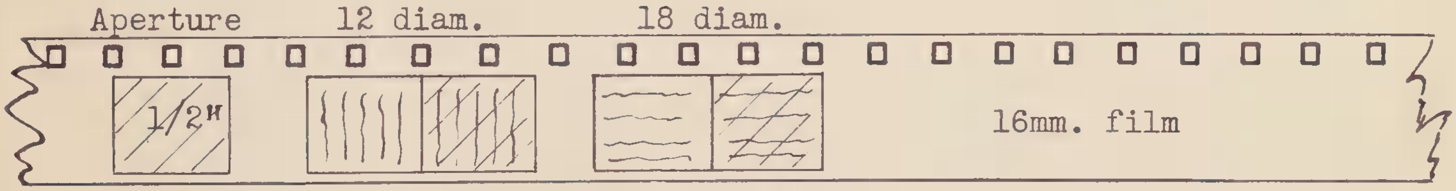
TABLE XLV

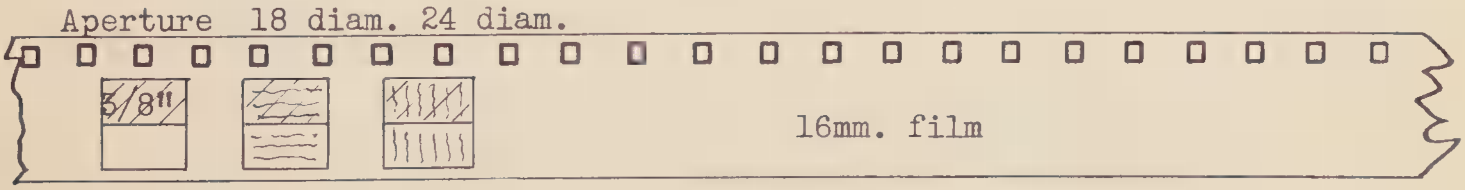

Aperture
6 diameters
9 diameters
1 1/2"
35mm. film

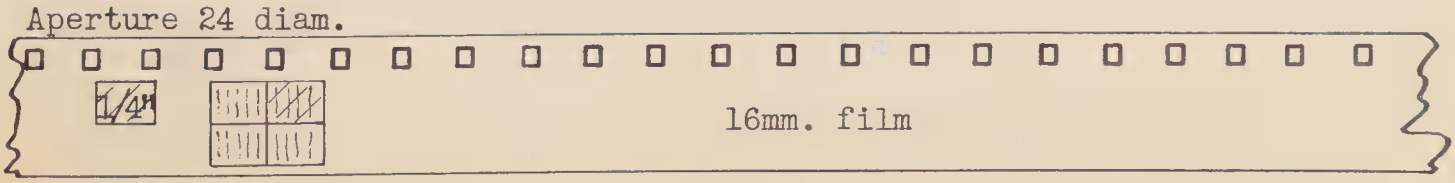

Aperture
6 diameters
9 diameters
1"
35mm. film


Aperture
9 diam.
12 diam.
3/4"
35mm. film


Aperture
12 diam.
18 diam.
3/4"
16mm. film


Aperture
12 diam.
18 diam.
1/2"
16mm. film


Aperture
18 diam.
24 diam.
3/8"
16mm. film


Aperture
24 diam.
1/4"
16mm. film

ratio can always be increased by bringing the lens nearer to the film, and setting the screen further from the lens. Thus a very cheap projector will make enlargements of 40 or more diameters by throwing an image on a distant wall. It does not follow, however, that a lens system devised to make enlargements of 10 diameters can be readjusted to make enlargements of 20 diameters, because the low power lens will not give the requisite definition, and the lighting system will not give the requisite contrast. The manufacturers of projectors will constantly be driven back to the alternative of sacrificing aperture for enlarging power, or enlarging power for aperture, or of sacrificing market if they standardize at a cost level that gives high enlarging power and large aperture.

The terms of the equation to be solved by the industry are now set. It remains only to discover exactly which alternative aperture-enlargement combinations are available at various cost levels. What are the combinations of aperture and enlargement that can be sold for $40, for $60, for $100? The figures arranged above, showing the immense effect of the high reduction ratios in cutting the cost of film will exert a pressure toward the adoption of high enlarging power with small aperture. The argument for low enlarging power and large aperture will turn on several points, of which the most important probably are:

1. That much equipment now in the hands of scholars is of the double-frame type, using 35mm. film, and with ordinary page copying this operates at the lower reduction ratios.
2. That the high reduction ratios in microcopying require a degree of skill that the scholar, an amateur in photography, often cannot supply. He can safely make mistakes in focusing, exposing, and processing at 10 diameters of reduction, through the same errors would be fatal if he were making reductions of 20 diameters.
3. That in short items made in unique copies, labor cost is so high in proportion to materials cost that the price advantages of high reduction ratios are illusory.
4. That the large-scale ventures in copying, such as the NRA and AAA code hearings, or the two million pages of early English books, which make the high reduction ratios so advantageous, involve the expenditure of such large sums that they could sustain the manufacture of special equipment for reading the films made in such quantity.

It is certain that there is a clear need for some reading equipment, such as the Recordak, that will handle reductions of 16 or more diameters by making enlargements of 16 to 20 diameters. Should all reading equipment be adapted to this use, or should there be an alternative line of projectors suited only to the reading of material copied in the zone of 10 diameters? If all reading equipment is to be adapted to the reading of material copied in the high reduction ratios, should it be designed to meet a low price level by sacrificing aperture? The analysis given above may clarify the problem and thus assist in its solution, but it cannot establish a proved answer.

The four companies now most active in developing reading equipment are the Recordak Corporation, the Spencer Lens Company, the Folmer Graflex Company, the International Filmbook Corporation, and Dr. Draeger of the U. S. Navy. Leitz, Bausch and Lomb, and Spencer Lens have projectors that can be used for projection reading, though not specifically designed for it. Leitz has a combination enlarger and projector. The Graflex is working on a combination camera and projector. Spencer Lens Company and Dr. Draeger are using the single-frame aperture of one inch; the Recordak an aperture of 3/4"; the International Filmbook Corporation is trying to keep the cost of apparatus down by keeping the aperture small, while Dr. Draeger and the Spencer Lens Company are working to keep the price down by contenting themselves with a low reduction ratio. The librarians in general, and especially Mr. Metcalf of the New York Public Library, and the promoters of microcopying in Washington, especially Dr. Draeger and Dr. Watson Davis, are working with the Bureau of Standards and with other agencies toward standardization. The conclusion is not yet clear, but the observer must testify to the clear intelligence with which those working in the field have envisaged the difficulty of the problem of standardization and have undertaken to grapple with it.

Conferences held in Washington, December 11 and 12, 1935, by various persons interested in the development of microcopying resulted in the following tentative proposals which were then circulated for review, and approved on behalf of the Joint Committee on Materials for Research by the Chairman and Executive Secretary.

I

There are three media of microcopying to be considered: paper, 35mm. film and 16mm. film. Since the use of paper does not involve the need for a projector, it can be considered separately, but the great convenience in filing paper microcopies as compared with film, and the relative cheapness of paper as against film, indicate that paper must not be ignored in the microcopying problem. Dr. Bendikson of the Huntington Library, Dr. Dallas Irvine of the National Archives, and the Folmer Graflex Corporation in the development of their new copying camera are among those who have most carefully thought out the possibilities of microcopying on paper.

II

Related to the distinction between the 16mm. and the 35mm. film, but not identical with the problem of the choice of film width, is the problem of reduction ratio on film for projection.

The International Filmbook Corporation and the Recordak Corporation and the Recordak newspaper copying enterprises contemplate the use of 35mm. film with a high reduction ratio (16 to 23 diameters, or over). Such high reduction ratios are also to be used on the 16mm. film. Lower reduction ratios are developed by users of the Leica camera and by the Bibliofilm Service of the Department of Agriculture, which uses the Draeger camera, especially in connection with the microcopying of short items. Any reading equipment can easily be equipped with reel-holding devices that will take either 16mm. or 35mm. film, and it should be a rule that designers are not encouraged to develop apparatus that will not permit the use of either width of film. In connection with the problem of enlargement ratio, a different situation exists.

III

Projecting equipment, granted that it is adapted to both 16mm. and 35mm. film, will vary in the following essential particulars:

a. It may be fixed focus or variable focus. The Recordak equipment has a fixed enlarging ratio of 22 diameters. The projective Folmer Graflex equipment will have a varying enlargement ratio that can be set at will. Each of these methods has its advantages and disadvantages.

b. Some reading equipment throws the image on a screen from which it is reflected back to the eye; other equipment throws the image through a semi-translucent screen. The Recordak and Folmer Graflex will be of the first type. The translucent reading machines will be the International Filmbook apparatus, the Draeger projection reader, and possibly the machine put on sale by the Leitz Company, and possibly the machine to be developed by the Spencer Lens Company.

c. Reading machines differ in the size of aperture; that is to say, in the amount of film they will enlarge for reading at one time. The Leica projector takes a double frame of 35mm. film, 1" x 1 1/2". The aperture of the Spencer Lens Company projector now contemplated will be a single frame, 3/4" x 1"; that of the Recordak is one-quarter of a frame; and that of the International Filmbook Corporation may be even less. In general, there is a relationship between size of aperture and enlargement power, because if the aperture is only one-quarter of a frame it will not permit the reading of lines of print that have been microcopied to extend across the full width of 35mm. film.

IV

Material that has been microcopied on 16mm. film at a high reduction ratio can be printed off on 35mm. film at a lower reduction ratio; material that has been microcopied on 35mm. film at a low reduction ratio can be copied off on 16mm. film at a high reduction ratio. This fact is of vital importance because it permits the purchaser of a low power projecting apparatus to order copies of any long run of 16mm., high reduction ratio film (as the NRA and AAA records) in a form that he can read. Conversely, the purchaser of a small aperture, high reduction ratio projector can utilize material that was originally copied with a low reduction ratio on 35mm. film, if he has it printed off on the reduced size.

V

Taking into account the foregoing facts and possibilities, it would appear that the following developments in projection apparatus can be integrated into a common system and so arranged that the products of any microcopying enterprise could be made available to the projectors of any apparatus, with a few exceptions that will be noted:

a. Double frame aperture, low enlarging power--Leica (now available but costly).
b. Single-frame aperture, fixed focus, 12 diameter enlarging power, reading by transmitted light--under development by Dr. Draeger.
c. One-half frame aperture, 22 diameter enlarging power, fixed focus, reading by reflected light--Recordak apparatus.
d. Variable aperture, variable enlarging power, reading by reflected light--Folmer Graflex machine.
e. One-quarter frame aperture, very high enlarging power, fixed focus, transmitted light--International Filmbook Corporation development.

VI

Large-scale copying enterprises, such as the proposed microcopying of books published prior to 1640, can be made on either 35mm. or 16mm. film, either at a high reduction ratio (as 16, 20, 23) or a low reduction ratio (as 9 to 14 diameters). If the master copy is made in a low reduction ratio, the possessors of Recordak or International Filmbook apparatus would merely purchase their film in a reduction on 16mm. film. If the original is made at a high reduction ratio on 16mm. film, the possessors of the Draeger, Leica, and presumably Folmer Graflex apparatus would purchase it in the enlarged form on 35mm. film. The newspaper material now being copied by the Recordak Corporation in a reduction of 16 diameters can be read presumably on any one of four reading machines: the Draeger projector will enlarge it back 14 diameters, at some loss of legibility, but it will show the full width of the newspaper page; the Recordak projector will show only one-quarter of a page, but enlarge it above original size; the International Filmbook machines will presumably show less than one-quarter of the area of the newspaper page, but may give it even more enlargement than the Recordak; Folmer Graflex can presumably be adapted to the reading of this type of film. Microcopies produced like the NRA and AAA series can be read presumably directly and without change on the Recordak, International Filmbook and Folmer Graflex equipment. For reading on the Draeger, Leica and Spencer Lens projectors, they would be reproduced for the purchaser in 35mm. width, making the reduction equivalent to 11 1/2 diameters rather than 23 diameters. The short strips of film now being distributed by the Bibliofilm Service in reductions of 9 or 10 diameters can presumably be read on all projection apparatus except that of the International Filmbook Corporation, and doubtless if special instructions are given for the filming of such strips by the Bibliofilm Service they can be adapted even to the International Filmbook projector.

VII

Conclusion: it is submitted that this array of equipment will provide for the reading of any film now being used, or likely to be used, with present techniques, except such copies made at very high reduction on multiple exposure on 35mm. film. Such copies would be legible only in the Recordak and International Filmbook apparatus.

Film Storage and Durability

To the extent that microphotography is used merely as a substitute for interlibrary lending, the question of the permanence of the film is not important. There is no doubt that its stability is sufficient for a span of years in which a scholar is carrying out a specific research project. His collection of material, in microcopy form, will not go to pieces on his hands.

But if microcopying is to take the

place of publication, or if libraries are to alter their general acquisition policies to give a large place to film instead of paper, the fundamental question of durability of film must be met. Dr. A. F. Kuhlman, in an article on the preservation of newspapers on film, has stated the issue comprehensively:

> Before we are ready to preserve newspapers in film form, dependable and favorable answers must be found to a series of unsolved problems. First, the Bureau of Standards must settle the question of the life expectancy of the film record, The Bureau must determine: (1) the chemical and physical properties of the cellulose acetate film and of the emulsion and image produced upon it in filming records; (2) specifications for producing and processing the film to obtain the most usable and durable production; (3) the effect upon the film copy, while in use or storage, of various environmental conditions--temperature, humidity, light, human contact, etc.; and (4) specifications for storage and use. These points determined, it should be possible to predict, on the strength of verified data, the life expectancy of the film if produced, processed, stored and used under clearly specified conditions."[5]

The Carnegie Foundation has made a grant of $5,000.00 to the Bureau of Standards to study film durability, and the research was under way in the year 1935. The research had progressed sufficiently by January, 1936 to warrant the conclusion that cellulose acetate film, properly processed, offers a satisfactory prospect of durability.

Moreover, the extraordinary evidence on durability that comes to light with the preservation of microcopied material from the siege of Paris must not be ignored. The reduction ratio, it has been established, was 32 to 39 diameters from newsprint. The film was probably a nitrate collodion base, less durable in all probability than the acetate safety film. This discussion of durability has been based on the assumption that photographers will use a film base more durable, and a reduction ratio less exacting, than that which has survived for 65 years from the siege of Paris.

Correspondence with film manufacturers and motion picture engineers is inconclusive in establishing rules for the storage of safety film. Some advice special measures to insure controlled conditions of humidity and temperature. All are agreed that there is no special fire risk in the case of safety film. The Recordak Corporation does not recommend any special control of atmospheric conditions in the storage of film. The Bureau of Standards reports a probability that film will dry out if stored in atmospheres of deficient relative humidity, but dried film can be reconditioned and restored. The practical plan that was agreed upon as satisfactory at the Richmond meeting of a group interested in microcopying (May, 1936) is to store film in a metal cabinet, keep a cheap hair hydrometer in the cabinet, and maintain humidity by putting a sponge in the cabinet if it gets too dry. The storage of film will not impose upon librarians any significant special expenses.

Assuming the permanence of film and the suitability of ordinary storage space for its preservation, the microcopying of documents for the sake of preserving them will be paid for by savings in storage space under certain conditions. Figures prepared by the Recordak Corporation indicate that it will pay to microcopy documents that are to be retained for fifty years if storage space costs are more than $.014 per cubic foot per year, and if storage space costs $.028 per cubic foot per year it will pay to microcopy documents that are to be retained for only twenty-five years. The costs of Recordak copying are less than the costs of the filing cabinets required to hold the original material. The microcopying fixes all the documents in an unbreakable series. This is an advantage as a protection against loss of individual documents through theft or carelessness; it is a disadvantage if a file is still active in the sense that new material ought to be interspersed between material already filed.

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[5] A. F. Kuhlman: "Are We Ready to Preserve Newspapers on Films? A Symposium." The Library Quarterly, V, April, 1935, pp. 212-213.

Since library space costs $.40 to $.50 a cubic foot for construction (see Chapter II), and gives rise to further costs for lighting and heating, it would appear that the interest charges and maintenance costs of library space would pay for transferring material from paper to film. It does not follow from this fact that such a transfer of material is desirable, but only that it is economically feasible. The reduction ratio in microcopying that would bring about this cost relationship is of course a high one--sixteen to twenty-three diameters.[6]

The four methods in use for the storage of film are: (a) storage in cans; (b) storage on reels; (c) storage in a cartridge; (d) storage in partitioned boxes. The cans, such as those sold by the Jam Handy Company of Chicago at $3.00 per 100, are small tin pill boxes. They keep each short length of film in place, but they offer no protection to the ends, edges or surface of the film. The reels provided by the Recordak Corporation are suitable for long strips, just as the pill boxes are for the small strips; they protect sides and surface. The International Filmbook Corporation has a foolproof cartridge that can be inserted in the projection reading machine; it protects ends, sides and surfaces. The Leitz Company sells small metal boxes divided into twenty-five chambers each of which holds a five-foot roll of Leica film.

The preservation of the film involves not only the intrinsic stability of base and emulsion, but also requires special care in the processing, to the end that no traces of the developing or fixing solutions remain on the film; and it may call for the protection of the surface from abrasion in use. It is a question whether the film surface should not be given a special hardening treatment to protect it from abrasion. The International Filmbook Corporation claims that its projection apparatus is devised to prevent abrasion; the film is not in contact with glass while it is in focus in the projector.

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[6] COMPARISON OF COST OF OBTAINING AND STORING FILM COPIES OF MATERIALS WITH STORAGE COSTS OF THE ORIGINAL MATERIALS

Document size 8 1/2" x 11" (letter size).

A standard file drawer holds approximately 3,500 letter size sheets and a four-drawer file cabinet about 14,000 sheets. A four-drawer cabinet is 15" wide 30" deep and 51" high. It consequently occupies 13 3/10 cubic feet of space without considering the aisle space required.

Using a Recordak working at a 23-1 reduction 2,352 of the above documents can be photographed on a 100-foot roll of Recordak film. This roll of film costs $2.75 including development.

Fourteen-thousand 8 1/2" x 11" documents will require slightly under six 100-foot rolls of Recordak Film.

These will occupy 104 cubic inches or 6/100 of a cubic foot of space.

These will cost $16.50.

It is entirely practical to photograph 50 letter size documents per minute with the Commercial Recordak. Consequently, to photograph 14,000 of these documents will require about 4-2/3 hours. At $.40 per hour, the labor cost of photographing 14,000 documents will be $1.87.

* * * * *

Using the above figures as a basis:

13.3 cu. ft.-.06 cu. ft. = 13.24 cu. ft., which is the space saved by photographing the documents.

The film and developing cost plus the labor cost is $16.50 ÷ $1.87 = $18.37, which is the cost of obtaining the film copy.

If the documents are retained for fifty years it will pay to Recordak them if storage space costs more than $.0278 per cubic foot per year.

$18.37 ÷ 50 = $.3674

$.3674   13.24 = $.0278

If the documents are retained for twenty-five years it will pay to Recordak them if storage space costs more than $.0555 per cubic foot per year.

* * * * *

No allowance has been made in the above comparison for the aisle space required by the document files. Since at least 50% of the room space is required for aisles, this should be taken into consideration. We can consequently say that:

If the documents are retained for fifty years, it will pay to Recordak them if storage space costs more than $.0139 per cubic foot per year.

If the documents are retained for twenty-five years it will pay to Recordak them if storage space costs more than $.0278 per cubic foot per year.

If the cellulose acetate film base and emulsion should ever prove to be insufficiently stable, there is a chance that a microphotographic image on aluminum could be used. The firm of Siemens and Halske has developed a process which, as nearly as the writer can gather from available information, puts a photographic image on metal without a gelatine emulsion. The light, sensitive substance is an inorganic colloid, aluminum oxide. This is the "Seo Process." Negotiations for its introduction in America are under way.

Microcopying of Newspapers[7]

The use of microcopying in the preservation of newspaper files is of special interest to librarians for several reasons.

a. The library's investment in storage space is greater in the case of newspapers than in the case of books.

b. Newspapers printed since 1880 are perishable. Mechanical wood pulp paper began to be used about that time. A few newspapers today publish a special edition on permanent paper, and several suggested processes are in the field for preserving the wood pulp medium. The most tested process is that of the New York Public Library; a sheet of transparent Japanese tissue paper is pasted with rice paste over both sides of each sheet of newsprint. The cost of this process is $.04 a page.

c. There is no market supply of old newspaper files. Acquisition possibilities as well as prices of old files are a matter of accident. A library cannot plan an equipment of newspaper files with any assurance that it will be able to complete its plan.

From another point of view, newspapers would seem to be among the least suited for microcopying, because the price of original files of newspapers is low in terms of printed area of page. In copying the NRA records, for instance, microcopying distributed the copies at $.12 per 100 pages, when the only alternative was hectographing or mimeographing at $2.00 per 100 pages. The Recordak Corporation and the New York Times Company have arranged the microcopying of nearly 90,000 pages of the New York *Times* for the five years 1914-1918 inclusive. The positive copies of this file are offered to purchasers at $.66 per 100 pages. Since the bare subscription price of a year of the *Times* is only $18.00, or $.10 per 100 pages, it would seem at first glance that microcopying must be more expensive than original purchase.

	NRA and AAA hearings	New York *Times*
Price on paper	$2.00	$.10
Price on film	.12	.66

In both cases the cost of binding and storage must be added to the price of the paper copies, and the cost of a projector or projectors financed into the cost of the film copies. But when considerations of *storage*, *perishability*, and *availibility* are taken into account, the case for microcopying of newspapers is much better than the above figures would suggest.

A comparison of the different prices at which newspaper files may be preserved brings into a comparative scale the three alternatives now confronting libraries, namely:

1. Preservation by purchase and storage of original files which may be on perishable paper in most cases, on permanent paper in a few cases.
2. Preservation by photo-offset in a reduced scale on permanent paper.
3. Preservation by microcopying on film.

The figures on microcopying in items 17, 18, and 19 below do not take into account the important factor of "first cost" in making the original negative film. The Recordak project is financed on a risk basis like ordinary book publishing. Early estimates of the cost of the first negative set this cost figure at $.10 a foot, or $284.00 for the original negative. The

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[7] The reader is referred again to the interesting symposium published by Dr. A. F. Kuhlman in *The Library Quarterly*, V, (1935) pp. 189-214. "Are We Ready to Preserve Newspapers on Film?"

TABLE XLVI

COSTS OF ACQUIRING OR MAINTAINING ONE YEAR OF A NEWSPAPER FILE OF APPROXIMATELY 18,000 PAGES PER YEAR, BOUND IN 24 VOLUMES
(Based on dimensions and typography of the New York Times)

I.	Preservation of current file. (Not applicable to back files)		
1.	Subscription price, unbound, newsprint edition	$18.00	(perishable)
2.	Cost of binding	54.00	(perishable)
3.	Newsprint edition, including binding	72.00	(perishable)
4.	Rag paper edition, including binding	$170.00	(permanent)
5.	Cost of storage space for 24 volumes, minimum $48, maximum $72, average (See figures in Chapter II)	$60.00	
6.	Total for storage and file in permanent form	$230.00	
7.	Total for storage and file in impermanent form	$132.00	
8.	Cost of treating with Japanese tissue to render a file permanent	$540.00	
9.	Total cost of newspaper, binding storage, and Japanese paper treatment	$672.00	
II.	Preservation in photo-offset copy, on good paper, reduced to one-half size (Applicable to back files)		
10.	Twenty-five subscribers (quotations of 1931)	$1000.00	to each
11.	Fifty subscribers	540.00	
12.	One hundred subscribers	290.00	
13.	Two hundred subscribers	165.00	
14.	Four hundred subscribers	102.50	
15.	Eight hundred subscribers	72.00	
16.	Storage space for file (1/4 of full size)	$15.00	
III.	Preservation in microcopy form.		
17.	New York Times-Recordak price per year	$120.00	
18.	Reduced 16 diameters, 1st position on 35mm. film. perforated on one side, 2840 feet of film Price of film (process positive) including processing		
	At 5 1/2¢ per foot High		$156.00
	At 2 1/2¢ per foot Low		$ 71.00
19.	Reduced 20 diameters, 2nd position on same film as above, 1480 feet of film Price of process positive film including processing		
	At 5 1/2¢ per foot High		$ 81.00
	At 2 1/2¢ per foot Low		$ 37.00

cost of this negative is of course distributed among the subscribers to the sets of film, who buy their positive sets at $120.00. The price of the processing is set at a figure well below the maximum for this kind of work, and the project has been set on foot in such a way that the sponsors take the risk that they may not sell enough positive copies to distribute their "first cost," and to expect to gain a profit if the number of buyers more than distributes this first cost. It is probable that in this instance the actual first cost is much in excess of $.10 a foot because of the labor of collating the file.

A special condition that confronts those who would microcopy newspaper pages is set by the state of present equipment. The newspaper Recordak copies loose pages only. Each page of the newspaper is passed through the machine, first on one side, then on the other. In this way newspaper pages can be copied in sequence in the "first position" on the film, in a reduction of 16 diameters. If bound newspaper files are to be microcopied without disturbing the binding, two obstacles would have to be met. First, the binding of the papers often leaves the inner column obscured because of the thickness of the volume and the narrowness of the binding margin. Second, a great amount of moving of the newspaper would be necessary if it were to be copied in the "first position" on the film. The camera would first take page one, then the whole bound newspaper volume would have to be moved the full width of a page to permit the copying of page two, then back again for page three, etc. If the bound newspaper volumes were to be copied in the "second position," the reduction ratio would be greater because the whole height of the newspaper--22" in the case of the New York _Times_--would have to go on the same width of film that otherwise takes 18". The New York _Times_ microcopied in the first position is reduced only 16 diameters, in the second position it would have to be reduced 20 diameters.

There are some newspapers with larger sheets than the New York _Times_, and some with smaller print. This is especially true of old files. The experts of the Recordak Corporation testify that even these pages can be handled on 35mm. film, but some interested persons--notably Dr. Thomas Martin of the Library of Congress--feel that it is safer to count on using 70mm. film for particularly difficult copying operations. The newspaper file may be "bad copy" not only because of the large size of the page or the small size of the type, but also because of blurring or discoloration. Some of the Russian newspapers from the years of the Revolution, now stored in the Hoover War Library, are almost illegible in their present form because of this blurring of ink on a very poor quality of paper. However, with the example of M. Dagron and his microcopies in 32-39 diameters of reduction preserved from the year 1870, the technicians can probably be trusted to solve the microcopying of bad copy without breaking too far from the cost levels indicated by the experiment with the New York _Times_.

Another important element in the question of microcopying has to do with the attitude of the readers and research workers toward this form. In 1934 the New York Public Library did a great service to scholarship by utilizing microcopies of current months of the New York _Times_ in its newspaper reading room. The weight of opinion on the part of the readers was favorable to the use of films in preference to the newspapers themselves, largely because of the greater convenience in handling. The experiment was sufficient to justify the conclusion that readers will accept microcopied newspapers in lieu of the original files. The new reading equipment being devised will increase the advantage of the process, because it will make it possible for a reader to make his own photostatic copy of a part of a newspaper page whenever he wishes. This will reduce the cost of photostat copies of parts of newspapers to a materials plus processing cost, for it will make the reader his own photographer, eliminating expensive labor in the photostat room.

The present state of our knowledge regarding the advisability of depending on microcopying for the collection and preservation of newspapers can be summarized in a few statements:

1. No library should at present embark on a large scale plan for the purchase, binding and storage of newspaper files without taking into account the revolutionary implications of microcopying.
2. If, as now seems probable, an increasing number of newspapers offer their current issues to libraries in microcopy form at a reasonable price, the chances are all in favor of preferring the microcopies to a wood pulp paper edition on grounds of permanence.

Microcopying and Library Cataloguing

Another special use of the microcopying process can be found in the copying of library catalogues. It has been stated above that the leading library problem of the present lies in the field of interlibrary coördination. It was the service of the last generation of librarians to bring the technique of collecting, accessioning, and cataloguing books to such a high point that a great library becomes in effect a running index, constantly brought up to date, of the world's knowledge. But as the demands of scholarship increase beyond the powers of any library to supply them, the logical unit for the next stage in organization becomes the interlibrary system.

One of the instruments of interlibrary coöperation is undoubtedly the union catalogue. The largest project of this kind is "Project B" of the Library of Congress, under the direction of Mr. Ernest Kletsch. The Library of Congress is filing in a great filing system the author cards of the holdings of all American libraries, especially the holdings of rare books. Already eight million cards are filed. But another use of the union list is in the field of library coöperation. If the libraries of a given region can centralize information about their holdings, they can not only save the scholar a great deal of time in discovering whether or not a given title is accessible, but they can make their accession money go further by avoiding unnecessary duplication in purchasing.

The need for "white collar projects" under the Works Projects Administration in 1935 led to the development of a technique for using microcopying in the preparation of a union list. Projects drawn up and submitted to Public Works authorities in the autumn of 1935 in Cleveland and in Philadelphia provided for the microcopying of all card catalogues of the libraries of each of these regions. The making of the cards for the union catalogue was then to be given to an army of typists, who would read the film copies of the catalogues. The reasons for copying indirectly, through film, rather than directly from the card catalogues of the participating libraries were, first, that the film copy could be made quickly, by one operator, using one drawer of cards at a time, and thus without disorganizing the functioning of a catalogue room; and second, that the typing and checking operations could be centralized in one room, with adequate supervision. Of course the cards would be more accurately and quickly copied if the film were enlarged by the available automatic enlarging machines to 3" x 5" card size, but the importance of using as large a proportion as possible of Works Progress Administration money for wages made it necessary to resort to typing.

However, a better technique for using microcopying in the compilation of union lists was worked out by Dr. T. R. Schellenberg and Mr. Paul Vanderbilt in connection with the Philadelphia union list project. They proposed to microcopy a catalogue, compare the microcopy film with a foundation catalogue of Library of Congress cards, designate the holdings indicated on the film copy by marking the Library of Congress card whenever the title was already present in the foundation catalogue, and punch the film whenever there was no card present in the foundation catalogue. The Recordak Corporation machinery would then pick out automatically and reproduce photographically on 3" x 5" cards the film items that were punched for reproduction.

Under some circumstances it may be advisable to reproduce a whole library catalogue on cards. Three photographic techniques are available for this purpose. A number of cards can be laid out on a flat surface and copied on a large sheet of photostat paper with the ordinary photostat machine. The sheet can then be cut up into 3" x 5" cards, and the cards filed. Or, the Dexigraph or photostat can be used to reproduce the cards one by one on 3" x 5" cards of photostat paper. This is the process used by the Library of Congress in its Project B; it was also used by Yale University Library in duplicating its great catalogue for internal administrative purposes. Then the Recordak Corporation can take a 16mm. microcopy of a card catalogue and enlarge it automatically on 3" x 5" cards. The photostat and Dexigraph methods yield a negative (white on black) card; the Recordak method a positive (black on white) card. The costs run from $20,000 to $30,000 per million cards.

There is a possible substitute for a union catalogue that may make its way in the future in library administration. A great card catalogue may be copied on the 16mm. film, and the catalogue itself held by another library for reference and checking purposes. A group of such catalogues might be called an "assembled catalogue" rather than a union catalogue. The cards would be consulted in the reading machine, like any other microcopied material. The cost of making a microcopy of a card catalogue, for this kind of use, would be only $500.00 per million cards, including labor costs. While it would be less useful than a union list in one respect--one would have to consult each library catalogue separately to determine whether or not a given book were available--it would in another way offer an advantage over the ordinary union list, for the whole subject entry classifications of a library catalogue would be reproduced. If, for instance, the film copy of the catalogues of the Library of Congress, the New York Public Library, and the Widener Library of Harvard University were on the floor of Columbia University Library, a scholar could check up quickly the holdings that each of these libraries had catalogued under a given subject head. This kind of use could not even be made of the great Project B union catalogue. The place of the "assembled catalogue" in library administration is untested. Another weakness in the use of the microcopy of a library catalogue as a basis for the organization of interlibrary coöperation is the impossibility of filing new entries between old ones. Perhaps the idea will prove most serviceable if it is combined with the union list idea. Libraries might procure microcopies of each other's catalogues, and then arrange for the exchange of catalogue cards on certain classes of future entries, or supplement the "assembled catalogue" (a number of copies of separate library catalogues assembled in one room), with a true union list of current acquisitions, made by filing one card for each new title acquired by each of the coöperating institutions.

Photography as the Scholar's Amanuensis

The analysis of costs and problems in the preceding pages has been devoted principally to the place of microphotography as a part of a library system. But the technique offers a variety of adaptations to the needs of individual scholars who may do their own work. Some scholars will find it useful to possess a camera that can be used for pictorial and document photography alike. For them the Leica or Contax, with its numerous accessory fixtures, is the best implement for microcopying. The selection of pages for copying and the copying itself are merged as one operation, so that labor costs in photographing do not appear; the photographing is part of the research. The scholars who have taken microcopies of documents have often found it necessary afterwards to enlarge them on photostat paper. If the material is such that enlargements will be necessary, a step can be saved by making the original photograph on a narrow strip of photostat paper in the Graflex camera, soon to be placed on the market. Or again, reflection copying without a camera may facilitate the gathering of records by a scholar.

Just as the scholars of the last generation found in general that it was desirable to be able to use the typewriter, so the scholars of the next generation will find it necessary to use photography. Just as each scholar works out his own note system, combining typescript and longhand notes, so the scholar of the future will make his combinations of typescript, longhand, photographs on paper, and photographs on film. Microcopying, as a technique in the hands of a man who does his own work of photographing and processing, is reduced to its bare materials costs. It offers the possibility that a scholar, by purchasing microcopies from libraries and by making his own microcopies of excerpts from books, may build up organized accumulations of data that will resemble a private library in extensiveness, and a note system in its internal organization. Pictorial and textual material can be fitted into the same file. That which scholars in the past have been able to do with the help of an amanuensis, the scholar of the future may be able to accomplish with photographic equipment.

It is possible that the development of this use of photography--whether on paper or film--will have an effect upon the intellectual standards of scholarship, for the technique will automatically tend to distinguish between that kind of intellectual labor that is merely the gathering together of documents and that which is the creative analysis of evidence.

The Merging of Collecting and Publishing

An even more sweeping change in the pattern of intellectual organization is to be anticipated from the full development of the possibilities of microphotography. The change that can be expected is one that, in a way, would restore a condition that passed out of existence with the invention of printing. For it was the technique and accountancy of printing that created the sharp distinction between the operations of collecting material and publishing. In the days of the manuscript, copies of a book were made to order for a collector; a possessor of a book was in a position to have it copied when a copy of it was desired. There was hardly any distinction between "published" and "unpublished" material. If a monastery maintained a scriptorium, and if its policy was to accede to requests for copies of its books, its whole library was, in a sense, "published" material.

Precisely this situation returns to the degree that microcopying becomes generally available. A library with a collection of theatre programs, or pamphlets of the revolutionary war, or historical manuscripts may adopt the policy of making microcopies of its materials upon request. If it adopts this policy, its whole collection becomes available to the world as if published. If the policy becomes widespread, so that one institution can expect to have its requests honored at other institutions, its collection can be perfected and rounded out according to a logical scheme. In that way, the making of a collection comes to resemble more nearly the preparation of a work of scholarship than a mere mercantile operation in the book market. Before the eyes of scholarship there looms a new unit of intellectual activity--the making of collections which will be "complete" within their predetermined limits to a degree that has been hitherto impossible. And this new unit, the collection, ceases to be functionally distinct from a publication.

The more clearly this merging of collecting with publishing is achieved, the greater will be the place that scholarship must give to the bibliographical and abstracting services that will guide the research worker through the embarrassing array of materials that will become accessible to him. The fact that a given item is printed as a book has hitherto served to give it recognition in bibliographical guides from which unprinted items are excluded. If this mechanical basis of distinction loses its significance, the emphasis upon intellectual bases of distinction must be greater than ever.

Some librarians have raised the question whether it would not be wise to make up special bibliographies of microcopies that are available. The problem they raise is important, but it leads beyond the point they have in mind. If a library has installed apparatus for microcopying and is willing to microphotograph its holdings on request, does not its entire holding become, in effect, available as microcopied material? If manuscript material is microcopied in Europe and brought to America, it becomes a new item, a new resource of American scholarship. But the same is true of a body of American manuscripts that may be discovered in an attic and deposited in a library that offers microcopying service. It is premature at this stage to do more than suggest how wide the new fields are in the science of librarianship that are now open for exploration. There is, however, one conclusion that can be drawn, even in the present state of the technique. This conclusion is that we may expect that the future will make the small libraries more important than they have hitherto been in the intellectual organization of the country. They will be able, not only to draw more freely upon the large libraries in the service of their scholars, but also to shoulder their share of the burden of maintaining the great archive of our civilization. Each unit in the vast library system can perform a task that will be proportionate to its resources, and yet fitted into the general scheme in a unique and useful way. The library may come to be, not only a depository of printed material, not only a collector of existing records, but even a maker of new records. It may come to be a part of the function of the library of the future to reduce to writing information that would otherwise go unrecorded. There is no community so small that it does not offer to a sensitive mind aspects of human life that are worthy of record, and facts that should be entered in the dossiers of scholarship.

CHAPTER XII

PHOTOGRAPHIC AND PROJECTING APPARATUS

In the discussion of the cost levels and possible applications of microcopying in the preceding chapter, allusion was made from time to time to specific makes of apparatus, either already on the market or under development. These must now be compared from the standpoint of initial cost and working efficiency. The microcopying cameras here compared and noted are the following:

Class I. Cameras designed to serve for pictorial photography, but adapted to use in document copying.

1. Cinescopie (Belgium).
2. E.K.A. camera, with Lemare accessories (used by Library of Congress in copying foreign archives).
3. Leica camera, with Leica accessories (used by many American scholars).
4. Contax camera, with Zeiss accessories (a later product than Leica, but similar in many respects).
5. Argus camera, an American camera resembling the Leica (front lens required).
6. Bantam kodak, an Eastman, quantity production, low-price camera.

Class II. Cameras designed primarily for document copying.

1. Ansco Universal copying camera.
2. Ludwig camera, made to order (used at Yale University Library, New York Public Library).
3. Filmograph (not on the market as apparatus).
4. Draeger camera (used at U. S. Bureau of Agriculture for Bibliofilm Service).
5. Commercial Recordak (used in copying the NRA and AAA records).
6. Newspaper Recordak (sole installation at Rochester).
7. Eastman bound-volume copying camera, 16mm. film (in process of development).
8. Eastman bound-volume copying camera for newspapers, 35mm. film.
9. Kennedy camera (made to order).
10. Folmer Graflex photocopying camera (in course of development).
11. Matson camera (built for Edwards Brothers, Ann Arbor).

The Camera and the Use of Film

These cameras differ greatly in respect of their use of film. One distinction lies between the use of the long and short roll. All the cameras of the first class take a short roll of film (three to ten feet); all the cameras of the second class, except the Ansco, take a long roll of film (100 feet or more). The Leitz Company has made an intermediate camera that takes thirty-three feet of film. Advantage lies with the cameras that will take rolls of 100 feet or more, because film strips of that length can take advantage of low processing costs, due to the development of machinery for the motion picture industry.

Another distinction lies between the fixed and variable frames. All the cameras of the first class have a fixed frame size for each exposure; some of the cameras in the second class have variable frame sizes. The variable frame is an advantage because it permits the more economical adaptation of film to copy.

Some of the cameras of the second class carry the principle of variability to the point where they can use either 16mm. or 35mm. film. The Draeger camera can even be adapted to the use of 70mm. film, and the Folmer Graflex machine to the use of paper. The more variation that is possible in the copying machine, the more closely film and copy can be adapted to each other.

Two of the cameras, the E.K.A. and

the Filmograph, use an unperforated film; some of the others use film that is perforated on one side only; others use film with perforations on both sides. The unperforated film yields a larger film area for the same price as perforated film, but misses the economies that can come from low processing costs in processing machinery that requires perforations. The film perforated on both sides can be adapted to use in a larger number of projectors and to processing in a larger number of processing machines, but it is least economical in the use of the film area. Some large-scale processing machines will not print copies from a double-frame negative; they will work only with single-frame negatives. The machines that use film perforated on one side only compromise between the desirability of devoting as little film as necessary to perforations, and the need for adaptation to moving picture machinery in processing. The characteristics of the different cameras in this respect are noted on the chart.

Another camera quality that affects the use of film is the optical system. In many cases, this is a matter of lens efficiency. The problem has been discussed in the chapter above on resolving power. Since a lens can often be purchased separately from the camera, and the resolving power of the lens reaches a maximum with the more expensive lenses, the lens might be considered separately from the camera, except for those cases in which the two are sold without the possibility of substitution. The Recordak cameras differ from all others in that they use a slit rather than a full lens.

One feature of the lens or focusing system is not unlike the control of film areas in its relation to the full use of film area. This is the ability to vary the reduction ratio. Two of the Recordak cameras work with a fixed reduction ratio and fixed focus.

A related element of structure in the camera is its adaptation to copying areas of different size. Some camera equipment, notably the E.K.A. camera with Lemare Ampligraph equipment, does not easily lend itself to taking full newspaper pages. This is indeed a matter that may be controlled by the mounting of the camera rather than by the camera itself, but the mounting is an integral part of a well-designed copying equipment.

The Camera and the Mechanics of Operation

These cameras differ in the degree to which their operation is automatic, and hence in the labor costs of photography to which they give rise.

In general the cameras of the first class are the least automatic, and the automatic document copying features appear in the cameras of the second class only.

The features affecting labor costs of copying are the following:
(a) devices for holding copy in place;
(b) devices for focusing; (c) devices for making exposures; (d) devices for moving film; (e) devices for controlling relation of light to exposure.

The Recordak cameras can be provided with automatic light control; the Draeger and Folmer Graflex cameras have automatic focusing; the Ludwig camera has no automatic features. Sometimes the automatic features involve hand work, in other cases there is a motor attachment. These features of automatic operation are designated in the chart.

Another quality is portability, often found inversely related to automatic efficiency.

The complete equipment for micro-copying is often made up of so many different parts, or subject to such variations in assembly, that the chart above does not render a full account of the qualities of each machine. The machines are, therefore, listed here in order, with more complete descriptions.

Cinescopie and Photoscopie

A Belgium company began operations in the 1920's, with a catalogue list of "Film 'microphote' de la Photoscopie," as a cheap but efficient substitute for glass slides used in art study and visual education. It issued a catalogue of geographic, religious, scientific, and artistic subjects, and sought to interest the historical associations and library associations of Europe in its use as a preserver of pictorial and documentary material. The Photoscopie has its offices at 121 Rue Berkmans, Brussels; a similar enterprise, the Cinescopie, is located at 29 Rue aux Laines, Brussels. Cinescopie, like

TABLE XLVII

CHART SHOWING CHIEF CHARACTERISTICS OF COPYING CAMERAS

Name of Camera	Manufacturer	Price	Portable	Width and Length of Film Used	Lens	Copy Bound Materials	Frame Exposure	Automatic Features
Leica	E. Leitz, Inc. 60 E. 10th St. New York City	$130.50 with lens	Yes	35mm., perforated on one or both sides. 5 1/4 foot roll	f:3.5 50mm.	Yes	Fixed	Focal plane shutter makes double exposures impossible
Contax	Carl Zeiss, Inc. 485 Fifth Avenue New York City	$130.50 with lens	Yes	35mm., perforated on both sides. 5-foot roll	f:3.5 50mm.	Yes	Fixed	
Photo-Record Microfilm Camera	Folmer Graflex Corp. Rochester, N. Y.	Not set. About $200.00	Yes	16mm., perforated on one side; 35mm. perforated both sides; 70mm. perforated both sides; 70mm. paper. 100 foot rolls	f:3.5-2" or f:3.5-3"	Yes	Can be set for single or double frames	Automatic exposure time, film turning, and lighting
Recordak	Recordak Corporation 350 Madison Ave. New York City	Rents for $35.00 to $50.00 per month	By truck	16mm., perforated on one side		No	Variable	Automatic control of exposure time and lighting, turning of film, and fixed focus
Recordak Book-Copying Camera	Eastman Kodak Co. Rochester, N. Y.	Will be rented	Can be moved but not highly portable	16mm. perforated on one side; 100 foot rolls	f:4.5 32mm.	Yes	Variable	Button takes care of glass plate cover, lighting, exposures, turning film, and raising of glass cover
Recordak Book-Copying Camera	Eastman Kodak Co. Rochester, N. Y.	Will be rented	Can be moved but not highly portable	16mm. perforated on one side; 35mm. perforated; 100 foot rolls		Yes	Variable	Same as Recordak bookcopying camera for 16mm. film alone
Kennedy Copying Camera	Lloyd B. Kennedy 1556 Mahoning Ave. Warren, Ohio	About $300.00	By truck	16mm. and 35mm. perforated or unperforated. 400 foot rolls		Yes	Variable	Automatic shutter and film-moving attachments, automatic exposures
Filmograph	Carl Lundberg and H. C. Lambach of Seattle, Washington	Not on market	By truck	35mm., unperforated. 400 foot rolls		Yes	Variable	Automatic exposures, lighting, and film turning
Ansco Copying Camera	Agfa Ansco Corp. Binghamton, N. Y.	$65.00	Yes	35mm. perforated. 3 foot rolls	f:6.3	Yes	Fixed. One-half size of Leica frame	
Ludwig Camera	Frederick Ludwig Yale University New Haven, Conn.	$300.00	Yes	35mm. perforated. 100 foot rolls	f:3.5 50mm.	Yes	Fixed. Same size as Leica frame	
E.K.A.	Krause of Paris. Accessories by Lemare, 73 Rue Fondary, Paris	$165.00	Yes	35mm. unperforated 16 1/2 foot rolls	Tessar f:3.5 or f:4.5	Yes	Fixed. 30mm. x 45mm.	
Argus	International Radio Corp. Ann Arbor, Michigan	$12.50	Yes	35mm., perforated one or both sides 5 feet	Ilex f:4.5	Yes	Fixed. Same size as Leica frame; new	None
Cinescopie	Cinescopie, Inc. 29, Rue aux Laines Brussels		Yes	35mm., unperforated About 10 foot foll	f:3.5	Yes	Fixed	Automatic exposure up to one second
Bantam Kodak	Eastman Kodak Co. Rochester, N. Y.	$10.50 with supplementary lens	Yes	35mm. 5 feet		Yes		
Draeger Camera	Dr. R.H. Draeger c/o Bibliofilm Serv. Depart. of Agriculture, Washington, D. C.	Not set	Yes	16mm., 35mm., and 70mm. film. 1000 foot rolls	Tessar f:6.3	Yes	Ranges from 1/2" x 1 1/2"	Automatic focusing, timing, lighting, and film turning
Matson	Robert Matson	About $300.00	No	35mm., perforated on both sides. 200 foot rolls		Yes	Fixed. 3/4" x 1"	Automatic foot pedal controlling film turning and exposures

Photoscopie, issues a general catalogue of film subjects in all fields. The specifications of the Cinescopie camera are interesting. The machine is small: 9 1/2 x 4 1/2 x 6cm. The shutter makes automatically measured exposures up to one second, which is not sufficient for document copying. The actual film carrier takes a length of three meters of standard 35mm. film, which means 120 pictures. The film must be loaded in the dark. A "holder containing more film is contemplated for those who wish to take as many as 500 or more views on a single film. The camera can be fastened to any photo stand." The projector goes with the camera, can be fastened to a camera stand, and can project downward onto a table. The camera is the most portable of all; it is the only one that can really be carried in the pocket.

The Cinescopie suffers by comparison with the Leica or Contax camera because of the low resolving power of the lens. But the lens is satisfactory for making reductions of ten diameters from ordinary book type. The frame of exposure, while fixed, is smaller than the exposure frame of the Leica and Contax cameras, and therefore permits the copying of more pages per foot of film. The same observation applies to the Eastman Kodak Company's "Bantam," $10.50 including supplementary lens, and the Argus camera, $12.00 without supplementary lens.

For certain kinds of work, notably the copying of whole newspaper pages, the Cinescopie, Bantam and Argus would be unsatisfactory because of its low efficiency optical system. But in the ordinary copying of books, this is not a disadvantage; the purchaser of the Leica or Contax cameras should be warned that he is buying photographic power that the fixed frame of the film will not permit him to use anyway in the copying of book pages of average typography and size. A principal disadvantage of the Cinescopie as an aid to the American scholar is the absence of a commercial organization in America to take care of sales. The Bantam and Argus have sales organization, but no equipment to adapt to document copying.

The E.K.A. Camera and Lemare Ampligraph

The camera used by the Library of Congress in copying foreign documents from the archives was of French make, an E.K.A. camera manufactured by Krause of Paris, with accessories manufactured by Paul Lemare, 73 Rue Fondary, Paris, XVI.

In 1930 the E.K.A. camera and stand were quoted at 3,250 francs, and the manuscript box at 511 francs, the lights at 300 francs, not including cost of packing and shipping.

The camera uses a sixteen and one-half foot length of unperforated 35mm. film, taking 100 exposures on a loading. It must be loaded in the dark. The dimensions of the exposure frame are the largest of any used in microcopying: 30mm. x 45mm. This use of unperforated film lowers the cost per square foot of photosensitive surfact, but the large exposure frame cancels some of this advantage by using more surface than would be necessary with a maximum reduction ratio. The unperforated film limits processing possibilities also. While the E.K.A. camera is theoretically perfectly adapted to the copying of newspapers, the Ampligraph stand that Lemare makes for it does not give sufficient height or area for this work.

Leica and Contax Equipment

The most widely used camera for document copying is neither the Belgian Cinescopie nor the French E.K.A., but the German Leica. It is a multiple purpose camera, a piece of precision mechanism, for which innumerable attachments and accessories are available. Experiments in newspaper copying with the Leica were made with this camera in 1926 at the Hoover War Library at Stanford University; the camera used by Dr. Bendikson for microcopying at the Huntington Library at San Marino, California, is the Leica; Professor Krisopp Lake of Harvard University has used a Leica extensively in photographing manuscripts in the Near East; Professor James A. Barnes at Temple University is another pioneer. The equipment has become almost a standard implement in research work.

After the Leica camera had made a market, the Zeiss Contax camera appeared as a competitor. It resembles the Leica in its precision and its long catalogue of accessories. These catalogues are so extensive that the scholar may well ask for a Baedeker to guide him through them. The following paragraphs are written as an

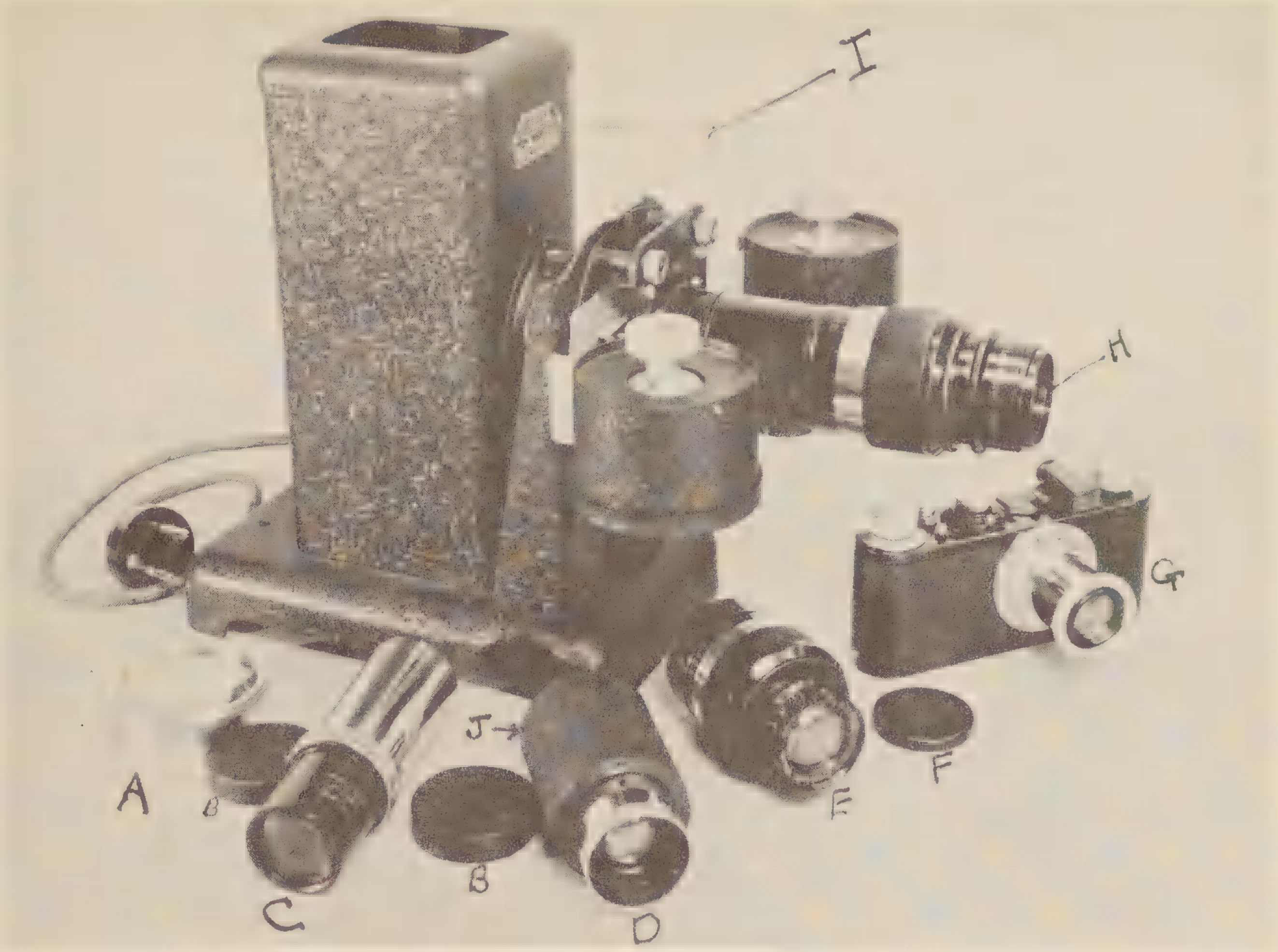

FIGURE LXVI

Leica camera, projector, and accessory lenses

attempt at such a guide, with equipment designated by number and code word. The differences between the Zeiss and the Leica equipment are not significant in respect of adaptation to document copying. Both cameras used a five-foot roll of 35mm. film perforated on both sides. Both have loading magazines which can be loaded with film in the dark and inserted in the camera by daylight. Neither will serve as a document copying camera until it has been supplemented with certain accessories.

(a) The Lens and Camera

The earlier models of the Leica, notably Models A and B, did not have detachable lens mounts. They are no longer advertised in the catalogues, and are available mostly in the second-hand market at a price of about $40.00. The normal equipment for both cameras is a 50mm. f 3.5 lens; the Leica lens goes under the trade name of Elmar, the Contax under the trade name Tessar. This standard lens, sold separately from the camera, is priced:

Leitz Elmar 50mm. f 3.5	$49.50 (50,320 ELMAR)
Contax Zeiss Tessar 50mm. f 3.5	49.50

The cameras, with these lenses, are priced as follows:

Leica Model D (50,030 LYKAN) ..... $81.00 (without lens); $130.50 with lens. Models F and G are higher priced, but the increased price pays for qualities that are of no value in document photography.

Contax Model I .... $130.50 with lens.

The Leica Model FF with magazine holding thirty-three feet of film sells for $195.00 without lens, or $244.50 with lens.

In order to equip these cameras for document photography, it is necessary either to have a supplementary lens that will focus at the necessary short distances, or to have an attachment that will remove the regular lens to a greater than normal distance from the camera.

The supplementary lenses are sold at the following prices:

Leitz Front Lens, No. 1 (minimum area covered in copying, 8" x 12"; 57,730 ELPRO) $6.30
Leitz Front Lens, No. 2 (minimum area covered in copying, 5" x 8"; 57,750 ELPIK) $7.20

Contax (Zeiss) Proxar supplementary lenses, corresponding to the above Leitz supplementary lenses, are listed but not priced in the catalogue material.

The Contax catalogue also refers to three Delta lenses, which are sold at $7.50 the set (#5520); these seem to correspond to the Leica front lenses in copying work.

With these supplementary lenses, the camera can be brought near enough to a page to make the page fill the whole frame of the film. The reduction ratio involved in the use of Front Lens No. 1 in copying a normal spread of two book pages with the Leica is a little more than eight diameters. In copying ordinary books, this reduction ratio, or something near it, is the only one that is possible because of the fixed frame size of the exposure area on the film. It must be noted that much of the high optical quality of the Leica and Contax cameras and lenses goes to waste in copying ordinary books because of the large fixed frame of the film, which does not suit reductions of ordinary pages to the high ratios that the resolving power of lens and film would otherwise make possible.

The alternative to the use of front lens equipment is the use of an extension tube, which is screwed into the lens mount. The extension tube, by increasing the distance between lens and film, makes it possible to bring the camera nearer to the object that is being copied, and hence to cover the full frame of the film with the image of a smaller object than the normal mechanics of the camera would permit. If the extension tube is used, however, the photographer must have a special device for checking the accuracy of his focusing. When the front lens is used, he can measure the distance from camera to object and focus the lens on a calibrated scale; when an extension tube is used, he must be able to focus directly on ground glass. There is no technical reason for this, for the Leitz Company might prepare scales that would permit measured focusing with each of the extension tubes. But in the absence of such scales, the use of the extension tube is tied with the use of "sliding focusing copying attachment," Model I or Model II.

The sliding focusing copying attachment is a device in which the lens is mounted in a holder that carries a ground glass at exactly the film distance from the lens. The camera, loaded with film, can be slipped away from the lens without spoiling the film; the focus can then be adjusted by watching the ground glass. Then the camera can be slipped back into place and the picture taken. The difference between Model I (57,600 FULDY), which sells for $24.75, and Model II (57,610 FULET), which sells for $13.50, is that the more expensive model lets the camera slide back and forth in front of the lens in grooves, while the Model II makes it necessary for the operator to remove the camera and lay it down on the table while focusing on the ground glass.

The Contax camera uses another device to secure the same result, for the Contax, unlike the Leica, has a removable back. The camera is unloaded, a piece of ground glass fitted in the place of the film, the focusing adjusted, and the camera reloaded. The ground glass focusing system of the Contax is much less convenient than that of the Leica because of the necessity of unloading the camera for each focusing operation. The ground glass focusing screen sells for $4.50 (#5520).

With the camera adapted for ground glass focusing, the extension tube principle can be applied. The Leica extension tubes are priced as follows:

57,635 (FULOR), 1.2cm. extension tube	$1.80
57,640 (UBECD), 2.2cm. extension tube	1.80

Either of these extension tubes will be sufficient for all ordinary document copying, but a tube that will permit the photographing of even smaller areas is the 3cm. tube, which sells for $2.10.

A study of the Zeiss catalogue does not show any attachment corresponding exactly to the Leitz extension tubes. Apparently the Delta lenses take the place of extension tube equipment. Therefore, the inconvenience of ground glass focusing with the Contax can be avoided, since the camera with the front lenses can be brought into focus at measured distances over measured areas by consulting a table.

To summarize: in order to adapt the camera for document copying, the photographer needs as a minimum, (a) Leica: either front lens ($6.50), or extension tube and sliding focusing copying attachment ($1.20 plus $13.50; total, $14.50); (b) Contax: three Delta lenses ($7.50).

The camera is now adapted to document copying from the optical standpoint. It remains to prepare a stand that will hold it in position. Here again a number of alternatives present themselves, but the minimal equipment is a sliding arm that will hold the camera and slide up and down on a rod.

The Leica sliding arm (57,620 VEARM) sells for $10.50; the corresponding Contax item is called a "reproduction bracket" (#995/32) and is priced at $27.00. The Contax bracket includes an attachment that is very useful, namely, a steel tape attached to the bracket to make measurement of distance from camera to baseboard a simple operation. Note that the greater convenience in measured distance focusing with the Contax bracket contrasts to the greater convenience in ground glass focusing with the Leica attachments.

The photographer now has his camera fixed to a bracket, but the bracket must be mounted on an upright rod, and the upright rod, attached to some kind of a base before he can begin work. The Leitz Company sells for $103.50 a "universal reproduction device" of basic equipment, which consists of baseboard, upright pillar, sliding arm, and steel tape measure. This equipment includes a special type of sliding arm that is especially convenient in using the ground glass focusing attachment. But the essentials are the pillar and the baseboard. Bought separately, the collapsible upright pillar (57,524 ZSL00) costs $31.50, the baseboard (VAF00) has no separate price listed in the catalogue. The combination pillar and baseboard in the Contax catalogue is listed at $12.00 (#1454/28).

The Leitz Company also offers a highly portable apparatus that will serve for taking ordinary book pictures, the name is "collapsible table reproduction device" (57,679 00ZIS), and it costs $33.00. There should be a quotation for a non-collapsible upright pillar in the 1935 Leica catalogue but the writer does not find it; in 1933; the 100cm. metal pillar was quoted at $8.00 (35,463 VERYN).

But the photographer can take leave of the catalogue and its prices when he has the sliding arm or bracket, for the baseboard is nothing but a board, and the pillar nothing but a column which can be made from any ordinary steel tubing, fitted to a flange and screwed to a board base. The writer made one for $1.50, and many scholars have built the mountings for their Leica cameras in various designs.

To summarize, the following minimum investment is required in setting up Leica or Contax document copying equipment:

Leica:	Camera and lens	$130.50
	Optical adaptation for document copying	6.50 (or $14.70)
	Sliding arm	10.50
	Pillar and baseboard (home manufacture)	1.50
		$149.00

Contax:	Camera and lens	$130.50
	Optical adaptation	7.50
	Sliding bracket	27.00
	Pillar and baseboard (home manufacture)	1.50
		$166.50

It remains to set up the lighting system. The lighting fixtures included in the Leica and Contax catalogues are not photographically superior to those that can be rigged from materials purchasable at the hardware store. Ordinary lighting fixtures with electric cords and plugs provide the source of illumination, and a system of reflectors must be used.

The account here made of the lighting problem is applicable to any installation. If it is desired to hold down the pages that are to be copied by means of a glass plate laid on them, the lights must be set far enough to the side so that they do not reflect from the glass into the lens. This side illumination requires more light than vertical illumination. Most ordinary lighting fixtures concentrate the light in spots; to distribute it evenly over the material to be copied is a principal objective of the photographer. This can be done by using reflectors with non-parabolic curves, and by diffusing the light through semi-transparent tissues such as tracing cloth or lens paper. The diffusion screen absorbs a large amount of light, and, therefore, makes necessary higher power lights or longer exposure time than would otherwise be called for.

The purchaser of photographic equipment will find opportunity in the Leica or Contax catalogue to invest a small fortune, but the minimum essentials are those set forth above.

The Argus

A camera and projector combination that deserves close watching is the Argus, manufactured by the International Radio Corporation of Ann Arbor Michigan. The camera resembles the Leica in many respects, but sells for $12.50. At the time of writing the tests of the camera for document copying had not been made, but the manufacturers are considering an adaptation to document copying. There is also a projector that is priced at $25.00, and this may be developed by means of supplementary attachments into a reading machine.

The Argus camera will never develop the automatic features proposed in the Draeger or the Folmer Graflex; it probably will not attain the optical efficiency of the Leica or Contax. But it may well turn out to be the American substitute for Leica and Contax, for it is going on the market at the low prices that quantity production permits.

Ansco Universal Still-Film Copying Camera

The cheapest of the many cameras designed specifically for document copying is the Ansco Universal Still-Film copying camera, which sells for $50.00 including camera mount. The lens is mounted on a frame facing a vertical copy board which can be clamped in position at any distance up to three feet from the lens. The copy board will hold a sheet 11" x 14", which is the largest size that can be photographed conveniently with this apparatus. The frame of film exposed is just half the size of the Leica or Contax area; it is a single frame camera, whereas the Leica and Contax are double frame cameras. This smaller area of film should call for higher optical efficiency in the lens, but in fact the lens system is much less efficient. Nevertheless, two pages of a book in large print, or one page of a book in small print, can be copied with this camera.

The focusing is done in a way that suggests the sliding focusing copying attachment of the Leica camera. The lens is fastened to a board, behind which two chambers can be moved. One chamber contains the film, the other is backed with ground glass. The chamber with the ground glass is placed behind the lens, and the copy is brought into focus. Then the film chamber is moved behind the lens and the film exposed. There is no shutter on the lens. The exposure is made by removing a lens cap.

The principal deficiencies of the apparatus, apart from the low quality of the lens, are the absence of any device to let the photographer know when he has used up his roll of film and the vertical position of the copy stand. The film loadings are very short--only three feet. A loading is fitted into a small wooden box, the box slipped into place in the film chamber, and a piece of the film drawn over some sprocket wheels. It is difficult but not impossible to reload the film magazine from a long roll of raw film. The film loadings, including the wooden magazine, are sold by the Ansco Company for $.50; they contain only $.06 worth of film. The film is moved by a downward pressure of the hand over the sprocket wheels. But there is no signal to let the operator know when he has used up his three feet of film.

Moreover, the holding of copy is very difficult. A book refuses to stand up with flat open pages, and even separate documents are not easily clamped in place. There are some good ideas in the design, but the equipment is certainly not suited to the needs of anyone who has more than an occasional document to copy.

The Ludwig Camera

The photographer of Yale University Library, Mr. Frederick Ludwig, has designed a camera based on the lens system and frame size of the Leica, but capable of holding a longer roll of film. His apparatus is a wooden camera, with a detachable lens, and a unique focusing system. The wide aperture of the 50mm. f 3.5 lens admits so much light that the ordinary process film acts like a piece of ground glass in focusing. There is a tube through which the operator can look at the back of the film while focusing. The frame used for this purpose is spoiled, but the convenience of focusing is so great that the loss of material can be ignored. The film is turned by hand; the exposure can be made with a shutter mount or by removing a lens cap from the lens. The focusing is quickly done, but it is often not accurate enough to take full advantage of the efficiency of the lens. This makes little difference in copying ordinary book pages, because the large frame size of the camera exposure calls only for reductions of the range of ten diameters.

Mr. Ludwig has built a number of these cameras to order. They are the least expensive of the document cameras that take the 100 foot roll of film ($50.00 for the camera without the lens; $15.00 for the stand and bracket).

One of these cameras is installed in the New York Public Library, another was bought by the Carnegie Endowment for International Peace for copying Peace Conference documents, another is in use in Spain for copying documents that are studied at New Haven by Professor Rose of the Yale faculty.

The Matson Camera

Edwards Brothers of Ann Arbor arranged for the construction of a special document copying camera. Their designer, Mr. Robert Matson, started with a motion picture camera and adapted it to document photography. It has the smaller frame of exposure, thus permitting higher reduction ratios in book copying. It also has some automatic features, notably a foot pedal that makes the exposure and turns the film.

Consumers Research, Inc., made another document copying camera from a motion picture camera. Cameras adapted from motion picture apparatus start with the smaller frame size, the longer roll of film, and the rudiments of an automatic exposure system. In this respect, they are more promising than the Leica as the basic design for a document copying camera.

The Filmograph and Kennedy Cameras

Mr. H. C. Lambach of Seattle and Mr. Lloyd B. Kennedy of Warren, Ohio entered upon microcopying as a means of setting up the records of title abstract companies. They worked independently of each other into this field in the 1920's and 1930's, and each designed his own microcopying apparatus. In both cases, the automatic principle was carried forward to a high degree of perfection.

The Kennedy camera takes a long roll of film--1000 feet--but, of course, any part of it can be cut off and developed when exposed. The shutter and ratchet to turn the film are operated by a motor. The ratchet can be set to move the film any chosen distance for each exposure, and windows of varying sizes can be fitted in front of the film to vary the area of exposure. A variable frame necessitates the use of a lens large enough to cover the largest frame, hence a loss in resolving power. Either perforated or unperforated film can be used. In building a new camera, Mr. Kennedy would equip it to take either 16mm. or 35mm. film.

The lighting system is wired to a rheostat and voltmeter to stabilize the light intensity. In focusing, Mr. Kennedy makes a test strip to find the best chemical (as distinguished from visible or optical) focus, and then hooks his lens mount in the correct position. The focusing is more accurate but also more troublesome than with the Ludwig or Leica cameras.

The most interesting part of the Kennedy machine is the automatic device by which the exposure is made and the film turned by pressing a glass plate down on the page to be copied. An electric circuit, made and broken by contacts on the wooden frame that holds the glass, opens and closes the shutter, moves the film, and then rings a bell to tell the operator that the exposure is made and he can turn another page.

Mr. Kennedy counts on a speed of 5,000 exposures (10,000 pages) per day. He will manufacture this machine to order for a price somewhere near $300.00 and design into it such features as the purchaser may desire. The Filmograph equipment is not on the market.

The Draeger Camera

The Filmograph and Kennedy cameras were designed for use in copying title documents for abstract companies; the Draeger camera was designed for copying library material and research documents.

The Draeger camera is used in the Bibliofilm Service of the Library of the Department of Agriculture, and is installed in the Library of Congress. It takes 16mm. and 35mm. film, and can use a special 70mm. magazine. The lens is f:6.3; the frame of the film is variable, ranging from 1/2" to 1 1/2" along the length of the film; the film roll is 500 or 1000 feet; the operation is entirely automatic, only the turning of the book pages being required of the operator.

There is a prospect that the camera will be manufactured to order for libraries that intend to use it for developing a microcopying service. Dr. Draeger is interested in developing the design of the camera to meet the needs of scholars.

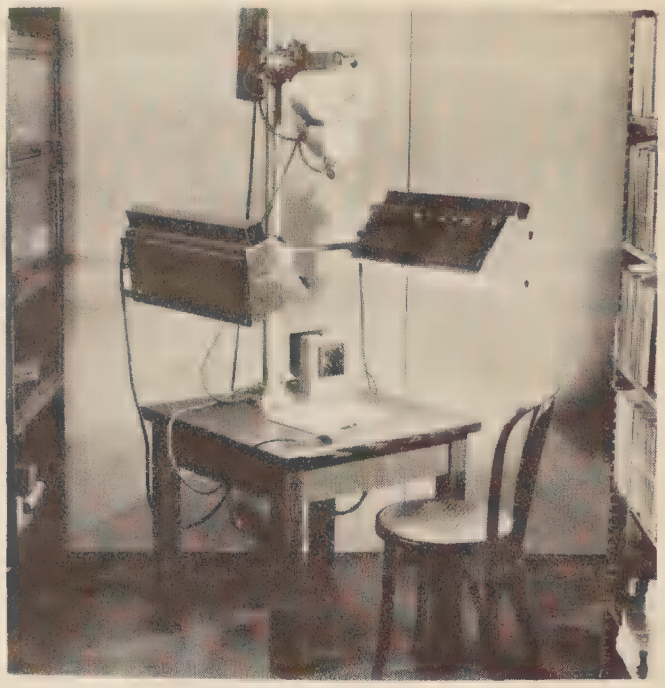

FIGURE LXVII

Draeger camera (early model)

The Folmer Graflex Camera

Mr. Edson S. Hineline, engineer of the Folmer Graflex Corporation, is working out a camera which will have extraordinary utility. The camera, now in the course of development, is expected to take, through interchangeable magazines, any one of four types of sensitized material: strips of paper 70mm. wide; 35mm. double-perforated film; 16mm. film perforated on one side; and 70mm. film with double perforation. The Factograph paper and the film strips will be loaded in 100-foot lengths. The possibility is anticipated of either loading film purchased in bulk in a dark room, or of loading specially prepared rolls of film in daylight.

With the 35mm. film, it will be possible to make not only the conventional double frame full-size exposure, but a single frame exposure one-half the customary size. This will permit conforming to the principle of maximum utilization of area without sacrificing simplicity and uniformity in projection and reading.

The camera will be provided with a

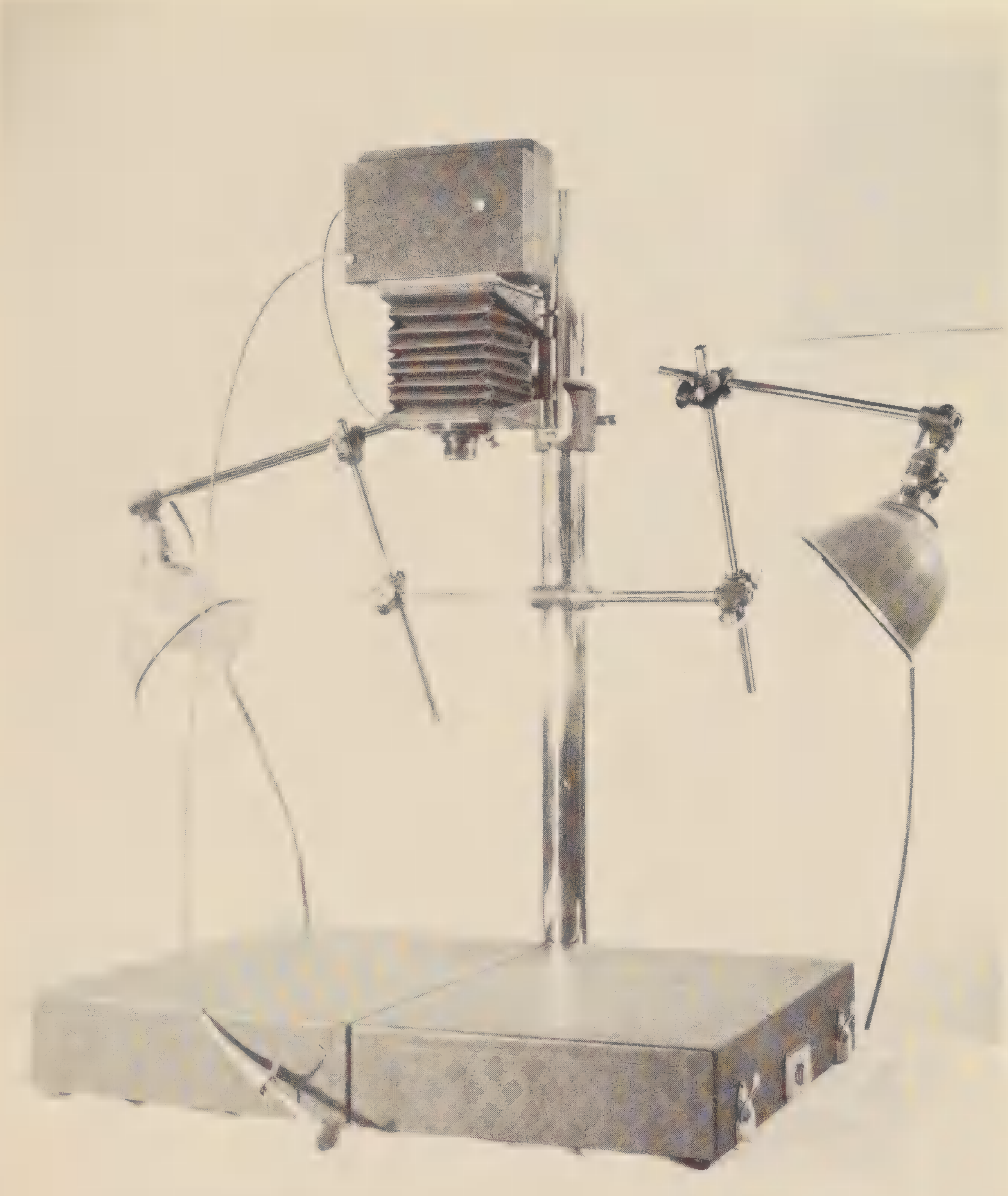

FIGURE LXVIII

New Folmer Graflex Camera

self-supporting stand, consisting of a sturdy separable upright column attached to the base. When the base is closed, it becomes the case for carrying the camera and its accessories. The case will be approximately 11" x 17" x 6".

The illumination will be provided by photo flood lamps supported from the main column in such a manner as to permit movement and adjustment to any conceivable location. The photo flood lamps will be connected with the resistor, which provides reduced intensity in the illumination except during the brief interval required for the exposure. This will not only prolong the life of the lamp, but will reduce possibility of eyestrain on the part of the operator.

The shutter can be set to predetermined exposure time within a broad range. The entire operation of the outfit after placing the book in proper position will be automatically governed by air pressure emanating from a foot treadle which will turn on the lights to full photo flood intensity, advance the film, and make the exposure of pre-determined duration. This will leave both hands free for the manipulation of the materials to be copied. A book cradle, which will be available as an accessory, will serve to keep the materials to be copied in the plane of focus through upward pressure against a plate glass.

The value of the machine as a device for copying documents and books results from the fact that it is designed for this specific purpose, and does not sacrifice this purpose to others, such as landscapes and art photography. Just as a Leica camera will do a great many things in pictorial photography, but only a few in document photography, so this camera has a marvelous elasticity in meeting the problems of reproducing research materials, but will not do landscape or art work.

If the scholar wants the cheapest possible paper copies, he can get them directly by loading the camera with Factograph paper (not indirectly, as in the Leica system, by photographing on film and enlarging). If he has a series of short items to be copied and filed separately, he can take them on paper or film cut into short lengths. If he has a long series to copy, he can take it on long rolls, like those that are made with the Recordak machine.

The development of this machine will be watched with special interest by scholars, because this camera is being designed for prospective quantity production and sales at a price that will attract individual buyers. The other automatic cameras are being developed more for the use of libraries with microcopying services. The price of this camera cannot be announced as yet, and the design is not finally established. It is hoped, however, that it will be adaptable to copying for any projection equipment, that the price will be something near the level of a typewriter, and that it may become for the next generation of scholars as indispensable as the typewriter.

The Recordak Bound-Book Copying Camera

The Eastman Kodak Company is developing a camera for copying bound materials. While it is still in an unfinished stage, some details of the new camera are known. The camera will be movable but, to quote Eastman, "it would hardly be called portable." There are two models, one for 16mm. film and another for 35mm. film. This film will be taken in 100-foot rolls. The lens used will be an Anastigmatic one with f:4.5 opening. Books up to 12" x 16" and up to 3" thick can be copied. The machine is designed to be almost entirely automatic. It will be motor driven and a touch of a button will automatically bring down the glass cover, insuring the material to be copied being under the focal plane. The same touch will light the lights for illumination, make the exposure, advance the exact amount of film required for the next exposure, and finally raise the glass cover so that the book is free for the next page to be turned. An automatic device will take care of raising the book to compensate for the decreasing thickness of the book as pages are turned.

For setting up the machine to copy a book, a light is projected through the film aperture onto the book, throwing a square or oblong form of light onto the page to show exactly how much of the page is being covered at that particular degree of reduction and setting the aperture diaphragm. The camera is then raised or lowered so that the width of this light

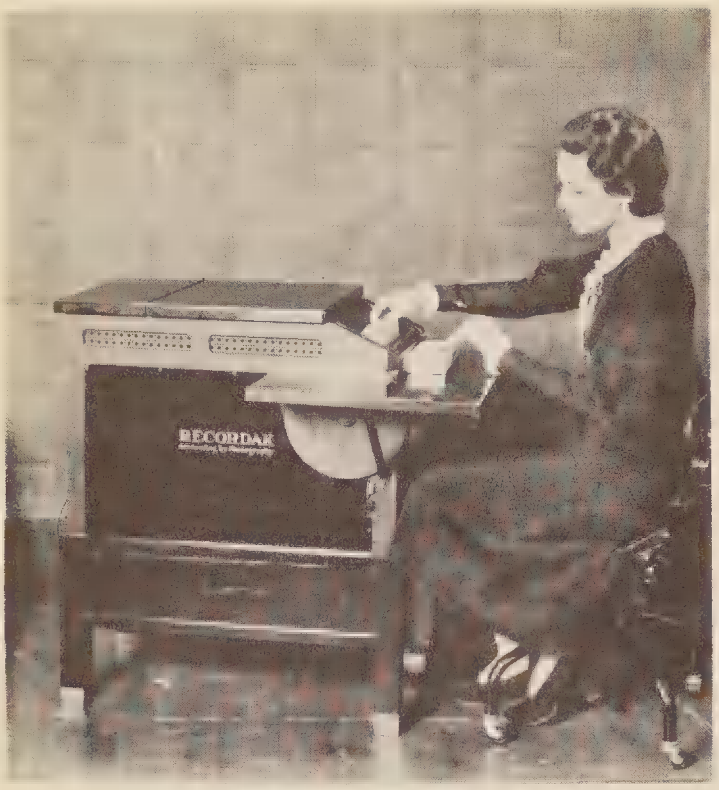

FIGURE LXIX

Recordak copying camera

exactly takes in the width of the printed matter to be copied. When this is set, the diaphragm of the aperture is adjusted so that the length of light fits the length of the material. This setting of the aperture diaphragm automatically sets the advancing mechanism of the film, so that just the right amount of film to cover this space is advanced after every exposure is made.

The Recordak Camera

The original development of the Recordak equipment was in the field of microcopying unbound documents. The machine was first designed for use in banks in the copying of checks; then its use was extended to the copying of other documents, such as charge slips in department stores. The first large-scale use of it for scholarly purposes was the copying of the AAA and NRA hearings.

The machine is about the size of a small typewriter desk. It is foolproof, not only in operation, but also in processing, for the Recordak Corporation combines the sale of its processing service with the sale of film. The loose sheets are fed into a roller, which carries them through the photographic field. They are photographed while in motion, the light reflected from the paper passing through a slit to a moving roll of film.

The Recordak machines are fixed focus machines. One model is set to make reductions of sixteen diameters, another of seventeen, a third of eighteen and one-half, and the highest of twenty-three diameters. The twenty-three diameter reduction is satisfactory for good typescript copy, but not for six-point type.

The machines are leased, not sold. The lease price is $35.00 a month for a year's rental, $50.00 for shorter periods. The processing price and the price of convenient reels and boxes for film storage are included in the price of the film--$5.50 for a 200-foot roll. These models all use 16mm. film perforated on one side.

The Newspaper Recordak

The newspaper Recordak machine is simply a machine of similar design to the commercial Recordak which will take a larger sheet of paper on its roller and photograph it on 35mm. film. The reduction ratio is sixteen diameters. Only unbound newspapers can be photographed. The newspaper Recordak is not available for use except at Rochester, consequently the files of newspapers are shipped to Rochester for copying. If the scale of business should warrant it, the machine could probably be supplied to institutions for lease or purchase.

Projector Reading Machines

In Chapter XI, the problem of the design of the projector was analyzed for its bearing on reduction ratio and standardization. In this chapter, the approach will be somewhat different. Each make of projector will be examined from the standpoint of reading convenience, and the optical quality of each will be regarded as only one of a number of important qualities.

The projector is related to the microcopy in three ways: first, it must enlarge the microcopy to legible size; second, it must conform mechanically to the width and perforation of film; third, it must adapt itself to the length of the film roll.

There are three families of

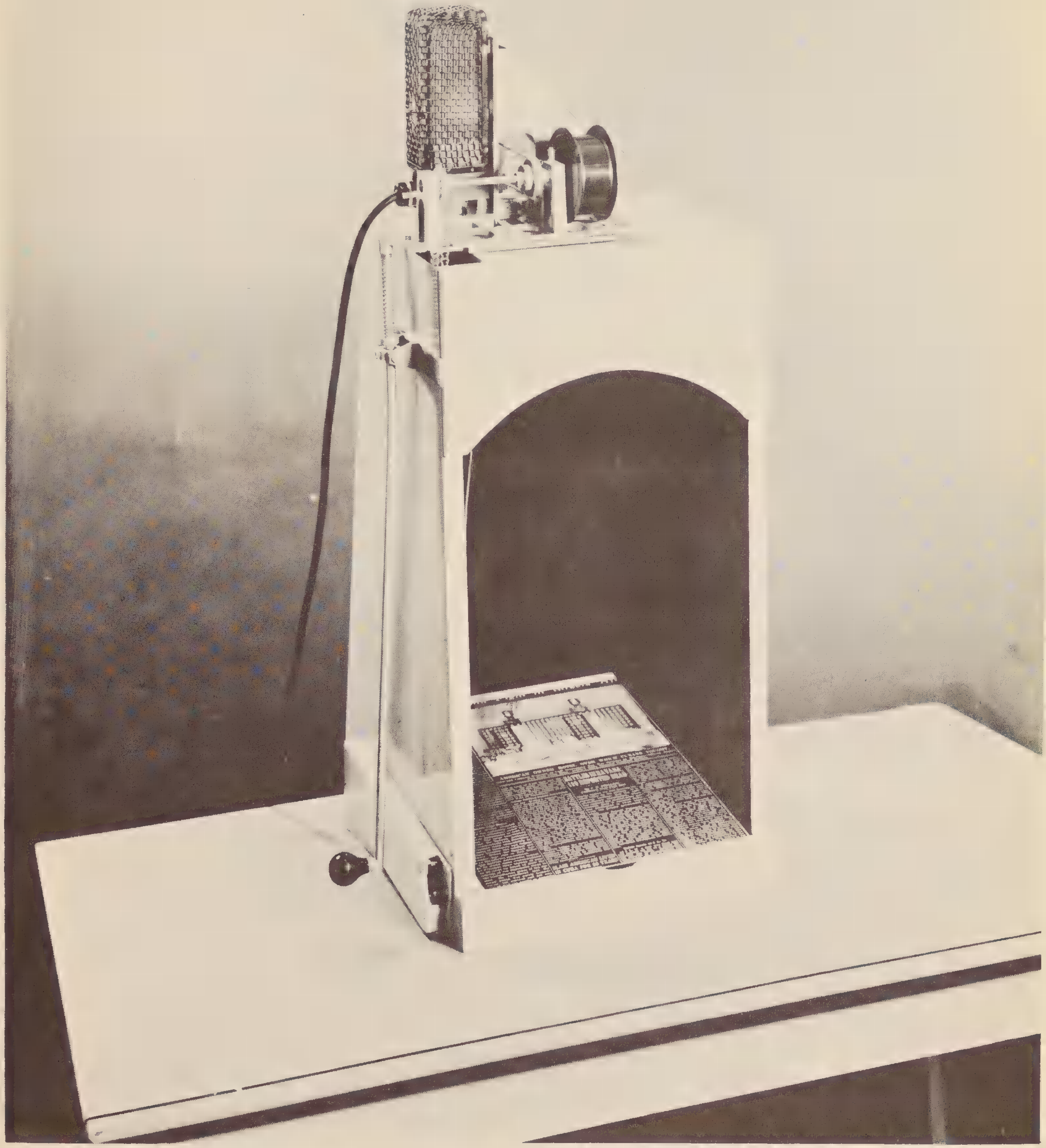

FIGURE LXX

Recordak Projector

projectors. The first consists of those that are essentially of the "magic lantern" type, intended for displaying pictures on a screen, and that are adaptable to the reading of films. The most important of these are the products of the Spencer Lens Company (the Delineascope), the Bausch and Lomb Company (the Balopticon), and the E. Leitz Company. All of them throw the image against a screen, from which the reader reads by reflected light. None of them offers high convenience in loading the film or in moving it from page to page while reading. Mr. Lloyd B. Kennedy has a reading machine that reflects the image from two mirrors successively, thus bringing it close to the reader's eye.

The second family is the reading machine type, developed for the specific purpose of reading film. All of these machines meet in one way or another the special problem of loading the film for reading. They fall into two main classes: those that project the image on a ground glass screen, so that the reader is confronted with transmitted light; and those that project on a reflecting screen, so that the reader encounters reflected light. The writer's experiments, and the observations of others, have induced a belief that the transmitted light is more fatiguing than the reflected light. According to Mr. Verneur Pratt of International Filmbook Corporation, this generalization is not true, but is the result of the use of the wrong translucent screens.

The third family of projectors is the combination camera and projector.

Another type of combination is found in the union of an enlarging with a projecting device. A projector that throws a right image through a translucent screen will not serve for an enlarger, because sensitive paper laid on such a screen will develop a mirror image. The projectors that throw the image on a screen for reflection to the eye can be converted into enlargers by excluding all light from the screen except the light that comes through the lens.

The chart of projectors shows the qualities of each in these respects, as well as their optical qualities and film adaptability.

The development of the reading machines is moving so rapidly that anything written at this moment will probably be out of date in a few months. The prospective purchaser of equipment should make inquiries of the following firms before making a decision:

Recordak Corporation
350 Madison Avenue
New York, New York

International Filmbook Corporation
Rockefeller Center
New York, New York

Spencer Lens Company
Buffalo, New York

Bausch and Lomb Company
Rochester, New York

Folmer Graflex Corporation (for combination camera and projector)
Rochester, New York

Dr. R. H. Draeger (U. S. Navy)
Care of Bibliofilm Service
Department of Agriculture Library
Washington, D. C..

With the reservation that all information here given should be checked against the developments of the next few months, there are a number of points of practical comparison between the different makes of projectors now being designed or manufactured.

The best established projectors are those of the magic lantern type, for their manufacture has been launched for other purposes than reading. All of them have the weakness that they are primarily adapted to a longer distance projecting than is convenient in reading. The Bausch and Lomb Balopticon and the Spencer Lens Delineascope take perforated film; the Leica projectors take unperforated. The Balopticon and Delineascope are more easily loaded than the Leica, for they receive the film from the side, while the Leica receives it from the end.

Neither the Balopticon nor the Delineascope is equipped with lenses that equal the 50mm. f:3.5 Leica camera lens, which can be mounted on a Leica projector. If a film copy of a newspaper page reduced eighteen diameters is projected on a screen, only about one-third of one-half of the area will be delineated clearly. If the center is brought into focus, the edges will blur; if the text at the edge is brought into focus, the center will blur. Since the entire page area is illuminated, but only a part of it brought into focus, there is a certain wastage of light.

The first of the specialized reading machines were those developed by Filmograph and Kennedy. Filmograph worked out a method of mounting projectors of the magic lantern type several feet above the heads of the readers and controlling the movement of the film by means of a long belt. This device must have meant difficulty in loading. Kennedy set the projector near the reader's hand and then placed a mirror about three feet from the projector to reflect the image back to a second mirror and thence to a screen. Both the devices thus got the necessary distance for projection.

The first of the Recordak reading machines used the principle of the mirror and ground glass, resembling in this respect the Kennedy apparatus. Later they were shifted to the principle that had been used in the Filmograph--the image was projected downward on a reflecting surface --and the movement of the film strip in front of the lens was controlled by a wheel set conveniently near the right hand of the reader.

The design of the International Filmbook apparatus is still undetermined in many respects. Its primary quality at the moment is a device for foolproof loading from a special cartridge, and a provision for the movement of the film to avoid abrasion. It will use the translucent screen for a reading surface.

Because Kennedy and Filmograph were exposing a large area of film, i.e., had a large aperture, they needed a long distance to get their projected image in focus. The Recordak, with a film area only about 16mm. x 20mm., could use a cheaper lens, shorter distance, and less light with the same result in legibility. The International Filmbook equipment seems to be carrying the principle of small aperture further than it is carried by the Recordak.

When the newspaper Recordak was developed, to read a newspaper page 18" x 22" on a double frame of 35mm. film, the problem of projection resembled that which Kennedy and Filmograph had met by providing a long distance between lens and screen. The Recordak technicians met this problem ingeniously by retaining substantially the same optical system that had been worked out for the small Recordak, and exposing only one-fourth of the newspaper filmslide to the light. Since the reader cannot cover with his eye at a reading distance more than one-fourth of a newsprint page, it was a happy idea to project only a part of the full page at a time. A lever within easy range of the left hand moves the film in front of the lens, thus bringing the different parts of the page successively into view.

A problem in all projectors is the ability to turn the film through ninety degrees, or to manage in some way to read microcopies which have lines running across the film strip and also those with lines running parallel to the film strip. Dr. Draeger has been most successful in solving this problem. The Recordak library projector has hardly met it at all. The International Filmbook Corporation has given it full attention. In the projectors of the magic lantern type, this problem is easily met by turning the film holder through ninety degrees.

Another unsolved problem in projector reading machines is that of shifting from small aperture-high enlargement to large aperture-low enlargement by changing lenses and condensers. Of course, a projector of the magic lantern type will give enlargements in any required degree, but only at the sacrifice of intensity of illumination. A projector to meet all purposes would be one which could be fitted with a lens and condenser that would magnify a double frame 35mm. film by ten diameters, and then by some simple shift could be changed to magnify a single frame 16mm. film by twenty-five diameters. Such a projector would read any microcopies now being made. The International Filmbook Projector is to have a turret of three lenses, and a slide with two condensers, to serve this variability.

The Recordak, and presumably the International Filmbook, Draeger, and Folmer Graflex projectors, will be provided with fittings that will make it possible to run

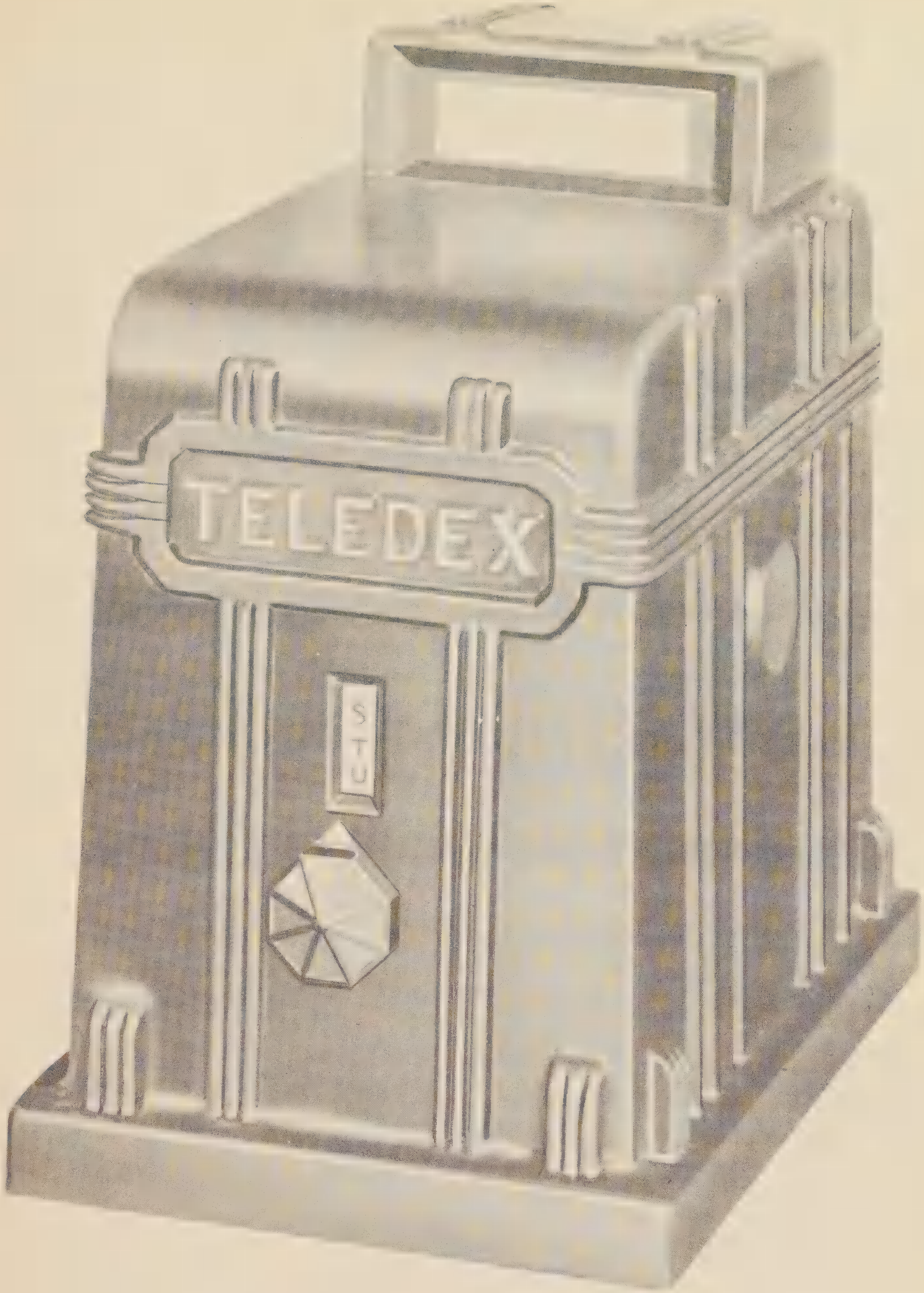
TELEDEX
STU

FIGURE LXXI

Teledex Projector

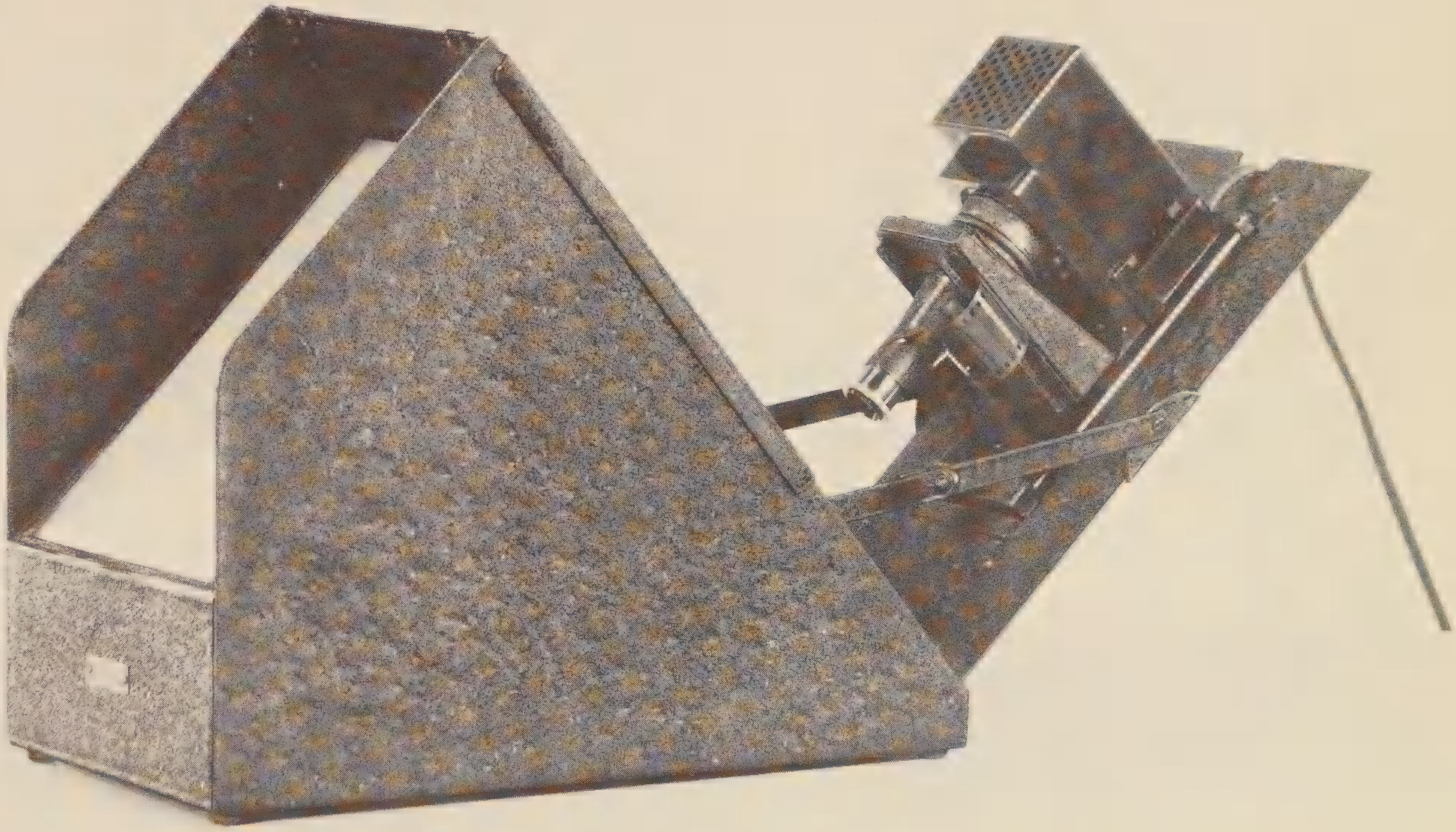

FIGURE LXXII

Spencer Projector

either 16mm. or 35mm. film; but none of them will permit a shift in aperture and enlargement ratio.

Another key problem in the design of projectors is the ease of loading and place finding. The tendency of design in place finding--which is important for long runs--is to introduce some kind of calibration which permits the reader to turn quickly to the desired place in the roll of film. The corresponding requirement for short runs is ease and rapidity of loading. The best apparatus from this standpoint would be one which could be loaded, either with a reel or a short strip of film, from the sitting reading position, without stretching the arm upward or outward. If loading could be made as easy as turning the pages of a book, the use of short-run film copies would be greatly facilitated.

While these observations are in some respect inconclusive, they do support the conclusion that the problems of design in reading machines are rapidly finding solution.

Projector-and-Enlargement Equipment

The combination of projector reading with enlarging machinery has already been noted as a possibility, and the possible development of low cost levels in making enlargements on paper from film has been mentioned. Dr. Draeger is designing an automatic enlarger that should give speeds of 5,000 to 10,000 pages a day. The essentials of such an enlarger are merely the automatic stepping of the film in front of the lens, the automatic control of light and exposure time, and efficient devices for paper holding.

Dr. Vernon D. Tate, of the National Archives, is working out another important part of the program of microcopying development. He is interested in the standardizing of instructions covering light intensities, exposure times, and processing. The conditions under which document copying takes place are subject to a far higher degree of standardization than those under which pictorial photography is carried on. The object photographed is a black and white, the light is usually artificial, and the range of distances and reduction ratios is small as compared with those encountered in general photographic practices. The emphasis in the technique is definitely placed on fineness of grain and high contrast. If the average research worker can be trained to be his own photographer, and to make enlargements from his own microcopy films, the resulting release from burdensome mechanical work in the collecting and organizing of material should have a marked effect on intellectual standards in research.

TABLE XLVIII

CHART GIVING CHIEF CHARACTERISTICS OF PROJECTORS

Name of Projector	Manufacturer	Price	Portable	Film Used	Type of Machine	Screen	Loading System
Balopticon	Bausch and Lomb Co. Rochester, N. Y.		Yes	Can use 35mm. with special attachment	Magic lantern	Reflected light	Side
Argus	International Radio Corp. Ann Arbor	$25	Yes	35mm. double frame	Magic lantern	Reflected light	Side
Delineascope	Spencer Lens Co. Buffalo, N. Y.	About $75.00	Yes	Can use 35mm.	Magic lantern	Reflected light	Side
Teledex	International Filmbook Corp. N. Y.	About $25.00	Yes	35mm. perforated or unperforated	Reading machine	Transmitted on translucent screen	Film cartridges
Optigraph	International Filmbook Corp. N. Y.	About $50.00	Yes	16mm. or 35mm., perforated or non-perforated	Reading machine	Transmitted on translucent screen	Film cartridges
UDIMO, 25515	E. Leitz, Inc. 60 E. 10th St. New York City	$36.00 without lens or condenser	Yes	35mm.	Magic lantern	Reflected light	
UMINO, 60,000	E. Leitz, Inc. 60 E. 10th St. New York City	$45.00 with lens	Yes	35mm.	Magic lantern	Reflected light	Side
Recordak Model 4	Recordak Corp. 350 Madison Ave. New York City	Rents for $2.50 a month	Yes	16mm., perforated on one side	Reading machine	Transmitted light on ground glass screen	Long rolls
Recordak Model 6	Recordak Corp. 350 Madison Ave. New York City	Rents for $5.00 per month	Yes	16mm., perforated on one side	Reading machine	Reflected light on reflecting screen	Long rolls
Recordak Library Model	Recordak Corp. 350 Madison Ave. New York City	Rents for $5.00 per month	Yes	16mm. and 35mm. perforated	Reading machine	Reflected light on reflecting screen	Long rolls
Filmstat Projector	Spencer Lens Co. Buffalo, N. Y.	Tentative at $50.00	Yes	35mm.	Reading machine	Image is projected on ground glass screen	
Draeger Projector	Dr. R.H. Draeger c/o Bibliofilm Serv. Depart. of Agriculture Library, Washington, D. C.		Yes	35mm.	Reading machine	Transmitted light	Long rolls
Bibliofilm Reading Machine	Bausch and Lomb Co. Rochester, N. Y.		Yes	35mm.	Reading machine		
Graflex Projector	Folmer Graflex Corp. Rochester, N. Y.		Yes	16mm. and 35mm.	Reading machine		Long rolls

CHAPTER XIII

THE RECORDING OF SOUND

Cost Levels of Sound Reproduction

The forward drive of technology offers the prospect of a number of new possibilities in the transmission of texts. Television may render long-distance reading a possibility. The transmission of facsimile texts by radio is on the verge of practical realization. The direct recording of sound is already in use for research purposes, and is definitely superior to written reproduction in certain fields of linguistics and music.

In general, the technology and cost relationships encountered in the reproduction of sound follow the pattern of those encountered in the reproduction of texts.

In disc recording of sound, for instance, the disc area is most economically used if it is made to rotate at constant linear velocity. The ordinary phonograph runs at a constant velocity in revolutions per minute. This means that the grooves in the short circumference near the inside of the disc are moving at a speed of one and one-half feet a second, which is adequate for the reproduction of sound frequencies up to 5,000. But the same number of revolutions per minute (seventy-eight is the international standard) would then carry the outside grooves of a large record at two or three times this speed. It takes two or three inches of groove at the outer edge of the record to reproduce the same amount of sound that is reproduced nearer the center on one inch. By varying the speed of the record in revolutions per minute, the velocity of the groove can be made constant. This economizes record space but increases apparatus cost. The relationship is precisely the one that is encountered in microphotography, where an increase in cost of apparatus yields an economy in cost of film.

The relationship of first cost to running cost is encountered in sound reproduction as in text reproduction. A set of master discs costs about $7.50 for one side, $15.00 for two sides of a record. The cost of making pressings from these is from $.55 to $.75 each, of fifty; or more are needed. But an inferior record can be made, one at a time, by "dubbing"--that is, playing the master record and recording it on a new disc. The dubbed records cost about $1.00 each. The cost structure here is like the comparison of photo-offset and photostat, and curiously enough, the two cost lines cross each other at about the same place--twenty-five copies.

As might be expected, the cost per word of sound recording is higher than the cost per word of text reproduction, but the spread is not so great as might be imagined. Fifty 12" discs would record 100,000 words. The filing space necessary to hold them would be a little more than a cubic foot. These records, in an edition of fifty, would cost from $2500 to $3000. A very expensive printing job, with copious illustrations, might well run up a cost very close to this.

The figures upon which these conclusions are based were furnished by Professor Miles L. Hanley, who has written the following description of the technique of sound reproduction.

TECHNIQUE OF PHONOGRAPHIC RECORDING

By Miles L. Hanley

Phonographic recording is rapidly becoming an indispensable tool for research. Conventional transcriptions cannot adequately represent the unusual intervals of folk music and many of the important characteristics of speech, such as voice quality, intonation, distribution of stress, speed and rhythm of utterance. Written records, however good, must contain a personal and subjective element. Without some objective check, their use requires an act of faith--faith that the field worker has heard accurately, that he has been able to translate what he heard into symbols, and that we know just what he means by his symbols. Phonograph records not only provide such a check, but they constitute a perfect archive of material which may be consulted and studied in the future.

After the invention of the phonograph in 1877, its obvious advantages to the linguist, the folklorist, the ballad collector and the anthropologist were promptly recognized by European scholars. The Vienna Phonogramm-Archiv was founded by Siegmund Exner in 1899, and the Musée Phonétique by Auzulay in 1900. Since then many other collections have been established: a second one in Paris, two in Berlin, and others in Cologne, Lubeck, Frankfurt, Leyden, Oslo, and Zurich. In America, although our scientists have made great advances in the mechanical technique of recording, our scholars have been slow to see the possible uses of this tool. It is true that some folk song and American Indian material has been collected in the past, but mostly by the unsatisfactory methods of cylinder recording or magnetic recording. So far we have nothing in America that could be called even the beginning of a central Phonogramm-Archiv, but we do have some important collections and many more are in prospect. A few of these are: Professor Greet's American Speech records which have been made at Columbia during the past ten years, the folk songs collected by John A. Lomax, the Gullah negro records made by Dr. Lorenzo D. Turner, and the records of New England speech made for the Linguistic Atlas of America (United States and Canada).[1]

Sound Recording Methods[2]

In all kinds of electrical recording, sound waves (periodic variations in pressure) produce mechanical movements--usually in a sensitive diaphragm. These movements are translated into corresponding electrical vibrations or variations which (usually after amplification by vacuum tubes) produce mechanical movements in a second diaphragm or a moving armature of some type. Electrical variations may be translated into light variations (sound on film) or into magnetic variations (Telegraphone, Blattnerphone). In the familiar phonographic technique, the sound vibrations are translated into mechanical movements of a stylus which cuts or imbeds a groove in a disc, cylinder, or strip of motion picture film.[3] The groove may be of constant depth, recording lateral swings of the stylus (lateral cut, "snake track," Berlinerschrift) or of varying depth (hill and dale, Edisonschrift). Hill and dale recording is used in dictating machines and in some very high-quality studio recording, but lateral cut records are most practical for common use at the present time.

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[1] See the American Council of Learned Societies Bulletin No. 23 for June, 1935 especially Professor Milman Parry's "Oral Poetry of the Southern Slavs," pp. 30 and 98; Professor Herskovits' Transcriptions of West African Music," p. 125; and the reports on the Linguistic Atlas Collection, pp. 22 and 87.

[2] For a full and authoritative discussion with excellent bibliographies see Technische Akustik, ed. E. Waetzmann, 2 vols., Leipzig, 1934. (These two volumes from Bd. XVII of the Handbuch der Experimentalphysik.)

An excellent and readable book on film and disc recording is Talking Pictures by Bernard Brown, 2d (revised) ed., London, 1933 (Isaac Pitman).

A compact and useful practical book is Home Recording and All About It by George J. Saliba, New York, 1932 (Gernsback).

Sound Projection (by Rudolph Miehling, New York, 1929 (Mancell Pub. Co.), while less up-to-date than the other books mentioned, may be found useful.

An abstract of G. Oscar Russell's, Mechanical Recording of Speech appears in Bulletin No. 4, Ling. Soc. Am., Sept., 1929.

A brief essay by H. A. Frederick, "Recording and Reproducing Sound" appears in the Review of Scientific Instruments, Vol. 5, No. 5 (May, 1934).

A discussion of recording materials is found in E. Nesper, Nimm Schallplatten Selber Auf! (Stuttgart, 3rd ed., 1932) and in the essay by H. A. Frederick referred to above.

See also the Journal of the Acoustical Society of America, The Review of Scientific Instruments, and The Bell Technical Journals.

[3] This last method, much in vogue in France, is not to be confused with the familiar moving picture technique in which light variations are photographed.

The recording methods referred to in the preceding paragraph may be classified as (1) Photographic, (2) Magnetic, (3) Mechanical. Since the particular kind of mechanical recording known as instantaneous recording on disc will be used in most research projects, the first and second will be dismissed with a few brief remarks.[4]

1. Photographic. In this method, electrical variations produce corresponding light variations, which in turn produce either a varying amount of exposure (variable density, Western Electric) or varying area (variable width, R.C.A.) on a photographic film. Equipment for this method can be easily portable and can be used under extreme climatic conditions, but the record cannot be played back at once. According to Dr. H. A. Frederick, duplicates, even commercial ones, show considerable variations from print to print. "Such duplicate records have thus far failed to show as great uniformity as disc record pressings. The individual film records are expensive, delicate, bulky, and difficult to handle compared with disks."[5] In contradiction to this statement it has been pointed out that duplicate prints produced by the large film companies are now fairly constant and that variations are mainly in the range above four thousand cycles. The fact remains that it would be difficult for the ordinary research worker to get copies of any such quality. The excellence of film recording is unquestioned, but the expense of this method is prohibitive for most research projects.[6]

2. Magnetic. In this method, electrical variations produce variations in the degree to which a magnetic wire (Telegraphone) or steel tape (Blattnerphone) is magnetized across its axis. This method requires special equipment and is not much more satisfactory than cylinder recording. Duplicates cannot be made, though of course it is possible, with special equipment, to dub the record on disc or film. The great disadvantage of the magnetic method is that, with the alloys now available, a wire or tape soft enough to record sensitively loses its magnetism in a short time.[7]

3. Mechanical. Mechanical methods include cylinder recording, scratching on motion picture film, studio recording on wax, and the various instantaneous disc methods.

Cylinder recording may safely be excluded. It is almost as expensive as disc recording, and much less satisfactory. The records are fragile, insensitive to high frequencies, difficult and expensive to duplicate, and quickly worn out by use.[8]

Recording by means of grooves scratched on motion picture film has not, so far as I know, been tried very extensively in this country. The material is not expensive, since discarded picture films may be used, but duplication is difficult and special apparatus is needed both for recording and playing. I have heard that there are difficulties in keeping the films flat and constant in velocity. The recording medium, celluloid or cellulose acetate, is also open to objections which will be discussed under disc recording.[9]

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[4] For technical information I am indebted to the expert knowledge of Mr. Lincoln Thompson of the Sound Specialties Company, Waterbury, Connecticut. He is not, of course, responsible for any faults in the present account, much of which is inexpertly condensed from his full and explicit discussions. I have also used a number of valuable suggestions from Mr. S. K. Wolf, Acoustic Consulting Manager of Electrical Research Products, Inc.

[5] H. A. Frederick, Rev. of Sci. Inst., Vol. 5 (May, 1934), p. 181.

[6] A photographic sound track may be put on disc. Such a record is of excellent quality and free from surface scratch because there is no surface contact. However, the method is not practical for most purposes and it is impossible to get more than two minutes of recording on a disc of ordinary size.

[7] A magnetic steel tape recorder recently built by the Bell Laboratories is said to give much better quality than cylinder recording. They also have tapes which are said to retain their magnetism indefinitely.

[8] Unfortunately most of the field recording done in the past has employed some kind of cylinder recording on the principle of the Edison Phonograph, and a great deal of valuable material is so preserved. It is to be hoped that no one hereafter will use such methods, but those who have cylinder records may be interested to know that they can now be electrically re-recorded on discs in this country.

Since most of us require records that can be made in the field and paid for from limited funds, studio recording on wax is usually out of the question. But if the material can be recorded in the studio and expense is no object, records can be made of a perfection that would have seemed miraculous five years ago. In studio recording, the groove is cut in a soft "wax" (really a mixture of metallic soaps). "The surface of the wax, after being thus engraved, is rendered electrically conducting. This can be done in a number of ways, such as dusting with graphite or bronze powder, sputtering with gold or silver in a cathode chamber, or by the chemical precipitation of silver."[10] The wax is then electroplated with copper and a "master" made. From this "master" or negative, records may be pressed, though in commercial practice, where many pressings are to be made, a "mother" is electroplated from the "master" and from that, one or more "stampers," that the master negative may not be worn out. The layman who does not understand the delicacy and difficulty of recording on a studio wax should see the process, or read a detailed account (e.g., that in Brown's Talking Pictures, cited above).

What might be called "semi-studio" recording has been tried by the Lautabteilung of the National Library of Prussia and by the Royal Irish Academy.[11] Portable apparatus for recording on studio wax exists, but it is much more cumbersome than apparatus for instantaneous recording and is open to many serious practical difficulties.

The remainder of this discussion will be devoted to instantaneous recording on disc. There are three kinds of methods: (1) those using a pregrooved record; (2) cutting; (3) imbedding.

(1) Pregrooved records have been widely used in home recording. There are two methods: In one the stylus point drops into the center of the pregroove, and produces a groove within a groove; in the other the stylus point fills the pregroove and produces undulations in it. The discs are expensive, but when a small amount of recording is to be done and high quality is not required, this method offers great advantages, since the ordinary pick-up arm is used and no feed for the cutting head is required. Very good records may be produced with this method by using a special turntable and powerful motor, but in this case the added cost of discs and special equipment is such that one might as well have provided a turntable feed in the first place.

(2) Instantaneous recording by cutting is similar to wax recording in that an actual chip is removed from the discs. Compositions of gelatin, celluloid, or cellulose acetate are generally used. Gelatin is sensitive to moisture and deteriorates with age. Celluloid is inflammable and cellulose acetate less satisfactory in quality than celluloid. "Metallophone" discs, made in Germany, produce excellent results, but the price is very high, especially for the twelve-inch discs. A new principle is employed in the Draloton disc, also made in Germany. The recording is done on a soft "bakelitartiges" material, which is afterward hardened by baking. The baking process, which does not injure the original record, makes it playable with a steel needle. But the Draloton disc requires considerable skill on the part of the operator, must be kept fairly cold, and deteriorates rapidly with age. For these reasons it is not a suitable material for field recording. The Presto Recording Company of New York markets a disc somewhat similar to the "Metallophone," which they

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[9] Direct cutting on the edge of a film has also been experimented with at various times. This method has obvious advantages for synchronizing sound and picture film. A development of this method known as the Spoor-Lindberg system has been tried in Chicago, but I have no firsthand knowledge of it.

[10] H. A. Frederick, Rev. of Sci. Inst., Vol. 5, No. 5, p. 176.

[11] See Royal Irish Academy Abstract of Minutes, Session 1928-29, Appendix, pp. 19-29; Proceedings of the Royal Irish Academy, 1930-31, pp. 20-26; Ibid., 1931-32, pp. 25-31; and Dr. Myles Dillon, "Report of a Linguistic Survey Recently Carried Out in Ireland," Atti del III Congresso Internazionale dei Linguisti (Roma, Seuttembre, 1934--xii).

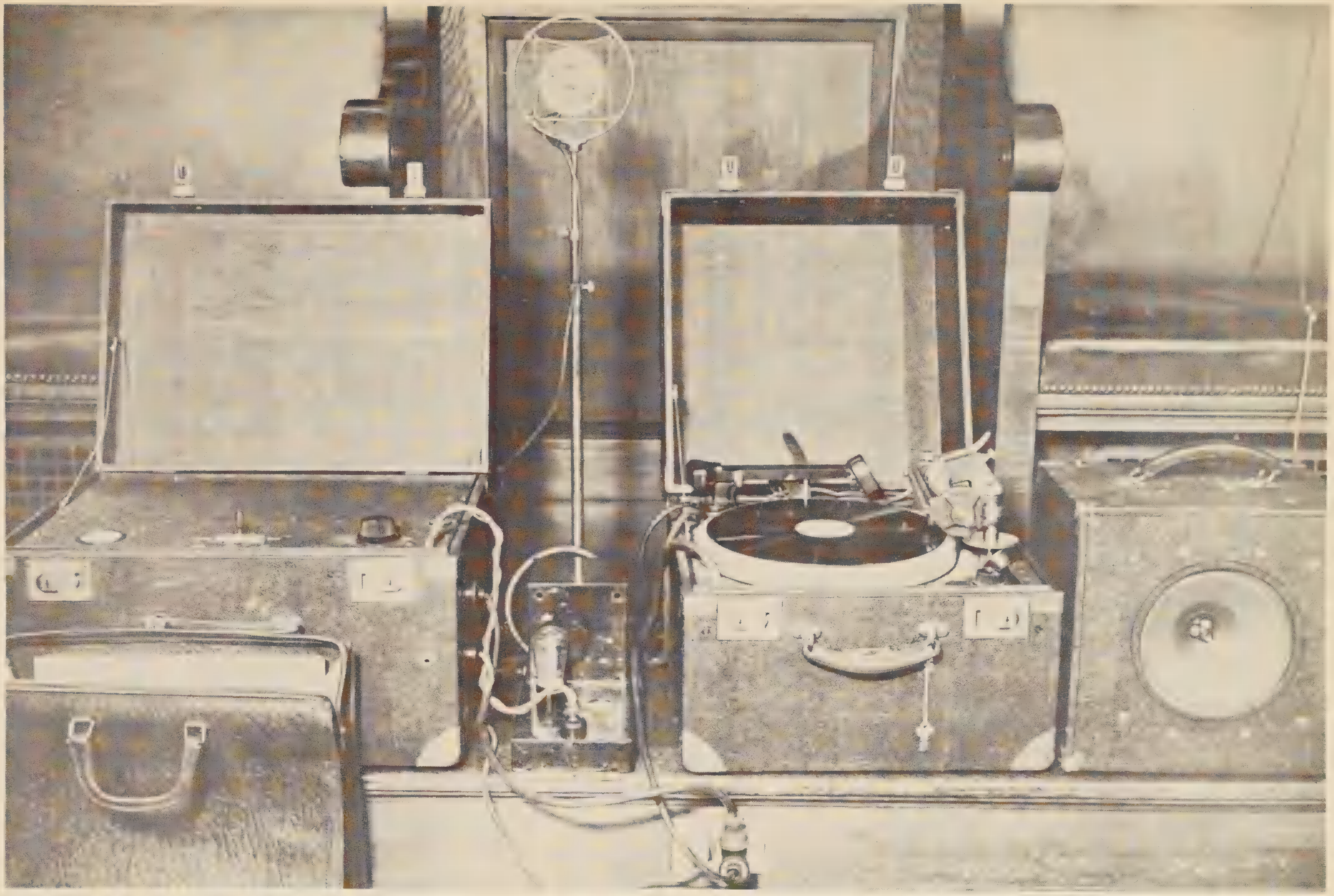

FIGURE LXXIII

Professor Hanley's Phonographic Equipment

claim to be even better. The records, however, are just about as expensive. A steel needle of a special type is used in reproduction. Under ideal conditions, the special discs referred to give considerable better results than aluminum, but since most of them are sensitive to heat or atmospheric conditions, or deteriorate rapidly with age, they are, on the whole, less suitable for field work than aluminum. The Marguerite Company of London uses a similar disc which has a smoother surface than the Presto, but is otherwise open to the same objections and requires a special trailing needle. An excellent disc of similar type has recently been perfected by the Sound Specialties Company of Waterbury, Connecticut. The disc is coated with a kind of cellulose acetate lacquer which hardens slowly with time. It may be played with any ordinary steel needle.

An important objection to the cutting method is that no provision is made for removing the long spiral chip, which tends to curl around the stylus. In studio recording the chip is withdrawn by a suction pipe as fast as it is formed. Both the styluses and cutting media available at present tend to be erratic. The same objections apply to records scratched on either nitrate or safety film.

(3) In the imbedding method, the stylus is fed across the disc at a uniform rate and presses a groove into the disc, which has been treated with some lubricant to reduce surface noise. Machine oil or axle grease is satisfactory, but the cleanest and most permanent lubricants are waxes, e.g., paraffin. The ordinary aluminum disc has a hard surface and requires a heavy weight on the recording head. It is obvious that additional sensitivity could be secured by the use of a softer medium and a lighter weight cutting head. For this purpose, discs softened by annealing have often been tried, with varying results. If annealed too rapidly, discs tend to curve and to record unevenly. Discs annealed slowly in oil, however, keep their original stiffness and produce better records. Apparently they will stand as many replayings with fiber needles as the harder discs.[12] A special sapphire play-back needle may be used on aluminum discs and gives excellent quality without injuring the records. Such a play-back needle, however, must be made to fit exactly the groove in which it is to be used. Consequently the records made by different machines will require different play-back needles.

Field Recording. For field recording, prime requisites are portability, ruggedness, economy and simplicity of operation. Other requirements will vary with individual projects. Almost all methods known to me have been mentioned, but in my opinion, the most suitable for most projects is disc recording on annealed aluminum.[13] It allows for satisfactory quality with simple operation, relatively low cost of equipment and materials, ease of storage, simple and accurate duplication. Single copies may be re-recorded on aluminum at slight cost, but if more and better copies are required, a metal master from which standard type records may be pressed may now be made by direct galvanic processes at a cost of under ten dollars for the making of a twelve-inch master and several pressings.[14] Portable outfits ranging in cost from $225.00 to $1,100.00 are now on the market. The finest portable equipment I have seen is that provided by Harvard University for Professor Milman Parry's expedition to Yugo-Slavia.

Power Supply. When dependable alternating current is available, it is, of course, the most convenient source of power. Otherwise batteries must be used. Some weight may be saved by the use of a powerful spring motor for operating the turntables, but in any case batteries are needed for the amplifiers. When working in New England I used a combination set, with which I could record on D.C. or A.C.

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12. Persons using discs in quantities of 500 or less will probably continue to buy from agents as heretofore. Those who use many discs can effect considerable savings by having the purchasing agents of their universities buy the discs directly from the Aluminum Company of America.

13. The coated discs referred to above are very much better than aluminum and should be used wherever possible. But for field recording where the source of supply is remote and discs must be carried for periods of several weeks, the aluminum is safer and not so likely to make trouble for the inexpert operator.

14. I should be glad to lend a copy of such a record to any one interested.

Microphones. The familiar one-button carbon microphone is inadequate for good recording, since it performs accurately only within a very small frequency range; but the best quality two-button carbon microphone, for example, the Western Electric 600A, gives a fairly uniform response. A good carbon microphone is satisfactory when the speaker stands fairly close to it so that small amplification is required; otherwise the unavoidable carbon hiss will produce a swishing noise in the record. The dynamic, crystal, ribbon, and condenser types require more amplification than the carbon microphone, but have no extraneous noise. The condenser is excellent in quality, but since it is sensitive to moisture and requires particular care, it is unsatisfactory for field recording. I have had no field experience with the new crystal microphone, but have heard very good reports of it. The choice between the dynamic and ribbon or velocity type depends on the nature of recording to be done. The ribbon or velocity microphone is highly directional, that is, picks up the sound coming from directly in front of it or directly behind it. This feature is often an advantage, since background noise is largely eliminated. The dynamic and crystal microphones are not so directional and are suitable for several speakers. Until recently the expense of good dynamic microphones has been prohibitive, but excellent ones may now be obtained at a cost of under $100.00. For most purposes the dynamic microphone is to be recommended.[15]

For aluminum recording it is best to use a pre-amplifier, for it is then possible to strengthen the frequency response at the point where aluminum is poor, namely above 3500, with a consequent gain in clarity.

The present discussion has been largely concerned with recording in the field, but there are many other practical uses of recording equipment. In laboratory experiments dealing with sound, it is possible to record simultaneously the sounds studied.[16] It is very easy to make excellent records of radio programs either as received or as sent out from the studio. Many important broadcasts are now so preserved. There are many obvious educational applications, among them teaching the pronunciation of foreign languages, testing musical aptitudes, correcting speech defects, adding sound effects to silent films, and, thanks to the process of hearing by bone conduction, in teaching the deaf.

Instantaneous recording with the latest type of discs opens up many hitherto unrecognized possibilities. Recording done with two turntables may be perfectly continuous, so that material in any quantity is recorded as it is produced. With a good transcribing instrument, such as is now available, one may play such records, localizing exactly the material of interest to him, and re-record on a new disc. Re-recording in the past has commonly meant serious loss in quality, but with the new coated discs, excerpts are almost indistinguishable from the original. This fact is of great advantage in dealing with folklore, ballad material, or anything produced by a naïve speaker, who cannot be expected to give a rehearsed and timed performance. The material may be edited and even rearranged.

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15. Though the velocity microphone has been used effectively in broadcasting studios, I should not recommend it for field recording. The directional feature is a disadvantage with inexperienced speakers, who frequently move about or turn their heads, and the low frequency response is so strong that unless a special filter is used, there is great danger of the fault known as "overcutting."

16. See Harry H. Hall, "A Recording Analyzer for the Audible Frequency Range," Journal of the Acoustical Society of America, Vol. 7, Oct. 1935, pp. 102-110. Records have been kept of all speech sounds analyzed by Dr. Hall's instrument.

CHAPTER XIV

CONCLUSION

Since the first edition of this manual was issued in 1931, the whole scene has been changed by technological developments. Predictions of that time have been realized in the actual appearance, not alone of new apparatus, but of enterprises on a large scale committed to the development of microphotography in scholarly documentation. It has seemed almost impossible to close the book, because the rush of innovation makes a chapter out of date almost as soon as it leaves the typist's hands. Even at this writing, information of future developments that may overturn some of the cost tables is in hand, though it cannot at this time be published.

Nevertheless, from this study there emerge certain general principles that seem to have constant application. If these principles are rightly understood, they can easily be applied to the new techniques and cost situations as they arise. Foremost among these principles is the importance of breaking away from the standards that are deduced from the technique and costs of ordinary publishing in print, and of viewing the whole problem of preservation and distribution of the records of civilization and the materials of scholarship in terms of a variety of techniques. The point of view must be functional, and the functions of technics in this field are simple: to convey to a certain number of readers a certain number of words with a certain degree of legibility and convenience, at a certain cost. If publishing can be treated as a process in which these four variables appear, and to which any one of a number of technical devices may be applied, the results will be nothing less than revolutionary.

How is a choice to be made among techniques? How is the most appropriate method of distributing a given text to be determined? When printing is assumed as the sole method of reproducing the material, the formula is very simple. There is given a certain number of words. The cost of printing that number of words is calculated easily. Then the actual or probable number of buyers must be calculated. If sales to these buyers at the price they are ready to pay will not liquidate the cost of printing and selling, a subsidy must be found. In order to make the number of buyers as large as possible, certain standard promotion expenditures are made and financed into the production cost. The equation works out with great regularity in the conclusion that any number of words can be published provided 2000 buyers will purchase them in book form at normal prices ($1.20 per 100 pages octavo).

Ordinary commercial publishing will take care of the distribution on any material desired by 2000 paying customers. But a vast amount of material for scholarly use and a great many of the products of scholarship do not and should not receive such distribution. This is the penalty scholarship must pay for specialization. Therefore the problem of scholarly publishing and of the distribution of materials can be approached more realistically if another question is placed first on the list, another of the four variables first determined. Let us ask then, how many copies of a given text ought to be distributed? and analyze the various techniques from the standpoint of size of edition.

Size of Edition. The Efficiency Point

Every technique of reproduction that applies the principle of first cost and running cost has some edition size at which it reaches an efficiency that corresponds to some other edition size in the case of another process. Of course, in all such techniques the point in edition size is ultimately reached when running costs are virtually the only costs that need to be considered. In the printing technique, for instance, editions of one or two million copies incur so large a running cost that the first cost appears only as a negligible item in the total. In microcopying short items to order, as in the Bibliofilm Service, where administrative costs are such that it is more economical to make a new negative for every order than to save negatives and make copies from them, the distinction between first cost and running cost disappears. The two costs are the same. Between these two extremes all the techniques of reproduction can be arranged in order in accordance with the size of edition at which they reach efficiency.

The efficiency point is specific for each technique. The simplest point at which to set it for each technique is at the size of edition at which running costs are just equal to first costs. In an edition that is smaller than the efficiency edition, a preponderant element in the cost of each unit is the first cost; in an edition that is larger than the efficiency edition, the preponderant cost element is the running cost.

The efficiency point, thus defined, can be calculated for each process from the tables of costs in the foregoing chapters. The simplest common denominator for finding this point is the percentage relation of running cost of 100 copies to the first cost of an edition. In photo-offset, for instance, the first cost of an 8 1/2" x 11" page is estimated at $2.00 for 100 copies, and running costs at $.30 for each additional 100 copies. It will cost $.30 to increase an edition from 100 to 200, and it will also cost $.30 to increase an edition from 2000 to 2100. The $.30 running cost is 15% of the $200 first cost. The corresponding percentages for all techniques are tabulated below in running costs per hundred copies.

Each technique has a certain minimum edition which must be reckoned as a part of the first cost. In printing quotations, for instance, an edition of 50 costs as much as an edition of 100, and therefore the edition of 100 is a minimum. The running costs really begin after the 100 mark is passed. In photo-offset quotations the minimum is sometimes 50, sometimes 100; in mimeograph, it is 50; and in hectograph it is 10. In photostat and microphotography the minimum edition is one copy. Running costs for 100 copies, stated as percentages of the first cost in minimum edition, stand as follows:

TABLE XLIX

RUNNING COSTS STATED AS PERCENTAGES
OF FIRST COST

Printing	5%
Mimeoform	8
Photo-offset, with composition, in the format of this book	10
Photo-offset, without composition, as in all reprint work	15
Mimeograph, (normal 300-word format) including composition	25
Hectograph, including composition	130
Microphotography, long runs with high first costs (as calculated for reproducing books printed before 1640)	
High running costs	730
Low running costs	1,500
Microphotography, long runs with low first cost conditions (met in photographing NRA and AAA hearings)	6,000
Microcopying, short runs under cost conditions of Bibliofilm Service, where cost of second copy is identical with cost of first copy, since negative film is not held for second copies . (This is the mathematical limit of the percentage relation)	10,000

From these percentage figures on running costs, the points of comparable efficiency in edition size can be calculated for each process. Cost of reproduction can be plotted as a curve, rising as the size of the total edition rises. At a certain point the curve will rise to twice the height of the starting point. In printing, this point will be reached at 2000 copies, in photo-offset (including composition) at 1000, in mimeograph at 400, etc. The full table stands as shown on the following page.

It would be possible to select some other point in edition size for purposes of comparing the various processes. For instance, we might ask, "At what size of edition will the unit costs be so compounded that only 10% of the cost of a copy is

TABLE L

EFFICIENCY POINT IN EDITION FOR VARIOUS PROCESSES

Process	Size of edition at which running cost equals first cost, and hence total cost of edition is double the first cost
Printing	2,000 (plus 100 in first cost)
Mimeoform	1,200 (plus 100 in first cost)
Photo-offset, including composition	1,000 (plus 100 in first cost)
Photo-offset, without composition	660 (plus 100 in first cost)
Mimeograph, (300-word format) with composition	400 (plus 50 in first cost)
Hectograph, with composition	77 (plus 10 in first cost)
Hectograph, without composition, as an alternative to typescript	40 (plus 10 in first cost)
Microphotography, long run, high cost of filming and low cost of processing	14 (plus 1 in first cost)
Microphotography, long run, high cost of filming and high cost of processing	7 (plus 1 in first cost)
Microphotography, long run, low cost of filming (NRA and AAA)	2 (plus 1 in first cost)
Microphotography, short run, cost of filming and processing not separated	1

incurred as a first cost in setting up the edition?" The edition sizes for the various processes would then stand as follows:

TABLE LI

EDITION SIZE AT WHICH 90% OF THE UNIT COST IS RUNNING COST, AND 10% FIRST COST

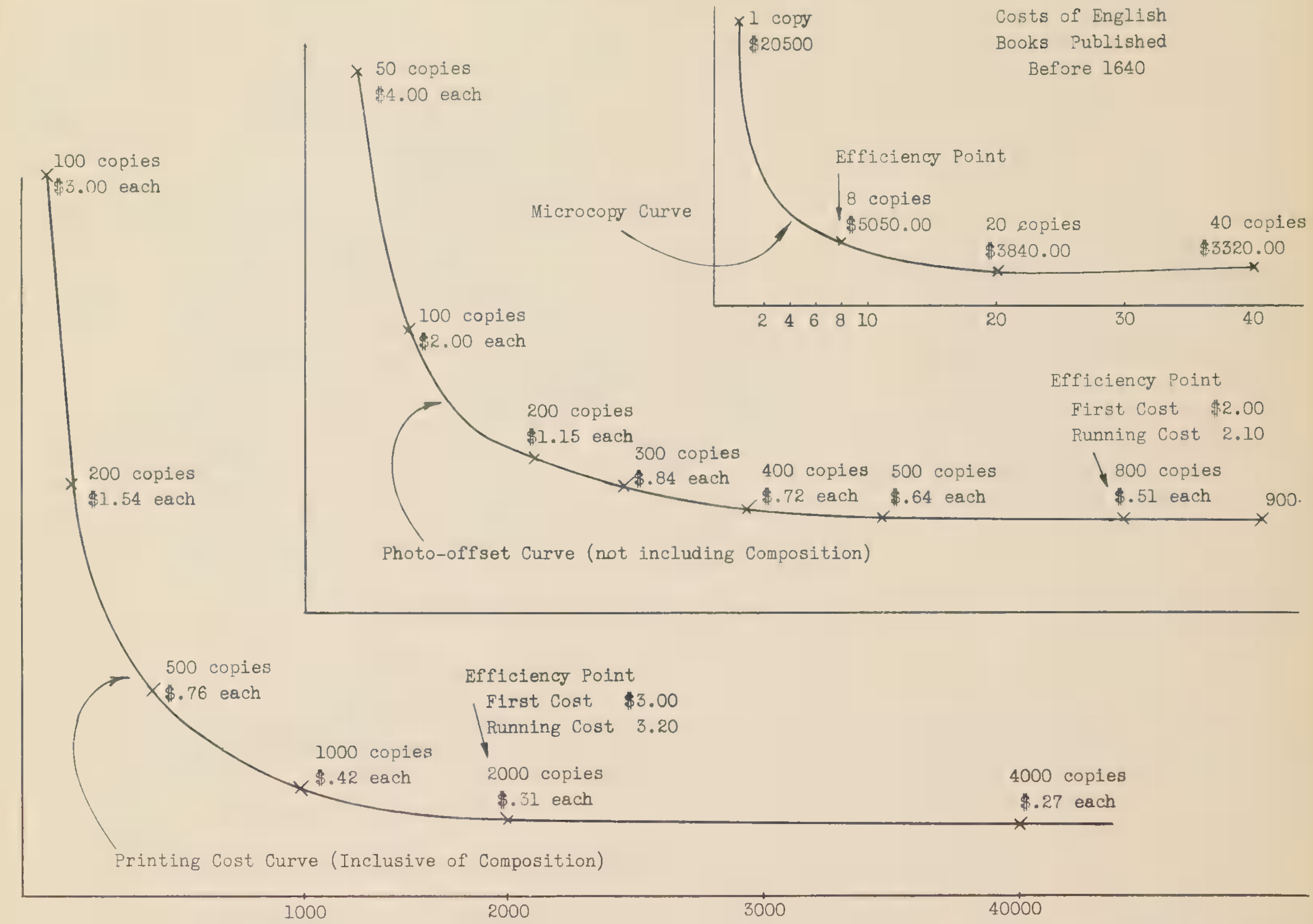
Process	
Printing	20,000
Mimeoform	12,000
Photo-offset, including composition	10,000
Photo-offset, without composition	6,600
Mimeograph	4,000
Hectograph (not technically possible)	
Microcopying, high first cost and low running cost	140
Microcopying, high first cost and high running cost	70
Microcopying, low first cost and low running cost	20

These tables indicate edition sizes so far out of line with the demands of scholarship in all techniques, save those of microcopying, that the better point of comparison is certainly the size of edition at which running costs and first costs are equal.

On the chart (Table LII, on the following page), the curve of cost-per-copy has been computed for three processes, with data taken from the tables in foregoing chapters. The curves for printing, photo-offset and microcopying are set to different scales, but the behavior of the cost curve is the same for each. In each case most of the economies in cost-per-copy that are obtainable are secured before the

TABLE LII

EFFICIENCY POINTS FOR THREE PROCESSES



efficiency point is reached. When the edition is carried beyond the efficiency point, the cost-per-copy continues to fall, but it does not fall so rapidly. This fact is of supreme importance in the strategy of publishing. It means that for any given number of copies there is some technique of reproduction that will function at or near its efficiency point. It means that the most accurate comparison of processes can be made if each is considered as functioning at its efficiency point. If only ten copies of a given document are needed, printing and photo-offset are out of the question, for their costs-per-copy are above photostat. If 2000 copies are needed, most of the cost advantages of microcopying disappear.

Comparative Costs per 100,000 Words at Efficiency Point

If each technique is understood to be functioning at its efficiency point, there is a sound basis from which comparative costs can be computed in numbers of words. It is true that the photographic processes, when divorced from composition costs, apply to page or film areas, rather than to number of words, and that the number of words on a given area of paper or film is related to a factor of legibility and convenience. But this variable can be taken into account in the statement of comparisons. (See Table LIII on the following page.)

The highest production cost at the efficiency point is that of the hectograph

TABLE LIII

COSTS PER THOUSAND WORDS AT EFFICIENCY POINT

Process	Efficiency Edition	Cost per Copy of 100,000 Words, Not Including Binding	
Printing	2,100	$ .58	(See table on economy format in Chapter III)
Mimeoform	1,300	.42	
Photo-offset, without composition as reprint from economy format slightly reduced to fit photo-offset plate	800	.50	(This is a 6¾" x 9½" page reduced to 6 x 9. The cost will vary with the degree of photographic reduction or enlargement)
Photo-offset, with typescript composition, in the format of this book	1,100	.77	(This is an 8½" x 11" page. Note that the cost is a variable dependent on format and degree of reduction or enlargement from typescript)
Mimeograph, in 300-word format	450	.64	
Hectograph, including composition	87	1.58	
Hectograph, without composition, when it is conceived as an alternative to the preparation of a fair-copy typescript, as in the doctoral dissertation published by Stanton L. Davis	50	1.00	
Microcopy, high first cost and low running cost	14	.33	(Figures from Short Title Catalogue, at 400 words per page)
Microcopy, high first cost and high running cost	8	.62	(Figures from Short Title Catalogue, at 400 words per page)
NRA and AAA type, with typescript pages figured at 300 words	2	.77	(at 300 words per page)

(including composition), roughly $1.50 for 100,000 words in an edition just short of 100. Another cost comparison of processes is that determining the edition size at which other techniques will multiply words at the same cost-per-copy ($1.50 for 100,000 words). The figure is a reasonable one to accept as a standard, because it is a manufacturing cost that will permit the distribution of books at prices that would be regarded by the book-buying world as moderate. (See Table LIV on the following page.)

The comparisons have been made with the costs of printing as a base line. But scholars often encounter another situation; they are familiar with another cost level. They will often wish to have a unique copy

TABLE LIV

EDITION SIZE AT WHICH COST OF PRODUCTION IS APPROXIMATELY $1.50 PER 100,000 WORDS

Process	
Printing, (economy format)	550
Mimeoform	200
Photo-offset, without composition, (reprint of pages, 700 words, 6" x 9")	150
Photo-offset, with typescript composition, (format of this book)	250
Mimeograph	115
Hectograph	90
Microcopying, long run, high first cost, low running cost, at 400 words per page	2
Microcopying, long run, low first cost, low running cost (as with NRA hearings)	1 (negative at 90¢, price does not rise to $1.50)
Microcopying, short run, Bibliofilm Service (Pages figured at 500 words to the page). The number of copies makes no difference, but the number of articles and their average length is crucial. 100,000 on 200 pages would be copied for $200, if all in ten-page lots; for $1.05, if all in one lot. The average length of item to be copied at $1.50 per 100,000 words would be twenty	1 copy each of ten articles of twenty pages each
Microcopy, short run. The services at Yale, Library of Congress, New York Public Library, etc., at $3.00 per hundred double frames, or 200 pages. At this rate the 100,000 words would be available as unique copy for $3.00	1 copy, or 200 pages. 100,000 words as unique copy for $3.00

of a document made and will face the alternative of having it photostated or copied on a typewriter.

The material which is normally thus photostated or copied in typescript is of two kinds: printed books, or stacks of loose typescript or manuscript pages. In order to compare the various techniques applicable to this demand situation, the same unit of 100,000 words can be used as an example. This would mean 250 pages of an ordinary book (400 words per page), or 144 pages of a book with 700 words to the page, or 334 pages of typescript at 300 words to the page.

Moreover, it is possible that a scholar might wish to make more than one copy by the devices that are primarily applied to the production of a single copy. The zone of edition size above the unique copy and up to the edition of fifty is very little developed in ordinary practice, although there are a number of reasons for regarding it as a very important zone. An edition of fifty copies will make any document accessible in all of the greatest libraries of the country, and in every section of the country. Therefore scholars should have in hand information on costs of production in this low-edition zone.

With these small-edition processes the reproduction of the book or typescript of 100,000 words begins always with one of the two basic procedures: a recopying on the typewriter, or a photographing, of the text as it stands. The first, being a composition cost, is the same for any unit of 100,000 words, whether it stands originally as a printed book or as a stack of typewritten pages. The second, being an area cost, is dependent upon the total area of page (the size of the page multiplied by the number of pages), and upon the degree of enlargement or reduction given to the material in photographing it.

The two techniques--copying on typewriter and photographing the existing pages --furnish alternative starting points. But there are a number of combinations in which the typescript copying is followed by some use of a photographic technique. The photographic techniques, since they permit reductions in size, lead to problems of legibility, and at a certain point begin to demand auxiliary reading devices, such as reading glasses, binocular microscopes, or projection reading machines.

The simplest classification of these processes is one that divides them into two main groups: first, those beginning with the making of a typescript copy of the text; and second, those beginning with the making of a photographic copy of the text. The second, or photographic, techniques will exhibit different costs, following the number of words per page and page area. A minimum for an octavo book is perhaps 400 words, a maximum 900 words. The table on the following page is calculated on the basis of a 400-word page, 6" x 9", and hence 250 pages of print as against 334 pages of typescript. The larger the number of words per page in the book, the greater will be the advantage of the photographic processes over those that begin with a retyping. The processes will yield two classes of result: those legible without optical aid, and those requiring the aid of a lens or projector reader.

The Allocation of Costs of Reproducing Materials

From the welter of figures and estimates set forth in the preceding chapters, and epitomized in the tables above, the conclusion follows inescapably that printing is no longer to be regarded as the sole technique by which the materials and products of research are to be reproduced.

It follows also that the financing of the reproduction and distribution of research materials may now be accomplished in ways that depart from the standards and practices of normal commercial publishing. The essential elements of commercial publishing finance are derived from printing technique. There has always been a high first cost, a low running cost, and consequently a profit in the large edition. There must, therefore, be promotional expenses to extend the market and draw in the largest possible number of purchasers. Commercial publishing will be most profitable if it can distribute the largest number of copies of the smallest number of titles. The needs of research pull in the opposite direction, toward the distribution of the largest number of titles in the smallest editions.

Microcopying techniques bring into the picture an entirely new pattern of financing. They impose upon the consumer the kind of "first cost" that printing imposes on the producer. Since the consumer, whether a library or an individual, must have a reading machine, he must make a substantial investment before he can read any microcopies. But after his investment is made, he pays only a small price for his reading matter. The more reading matter he procures, the more completely his first cost is absorbed.

Moreover, the microcopying techniques reach their efficiency point in so small a number of copies that promotional expenses are cut to a low minimum. It takes very little promotion to reach the necessary number of purchasers. And after the efficiency point is reached, later purchasers can be cared for by running off for each one the copy that he requires, without incurring the costs of a new edition. The problems known to commercial publishing as promotion, overprint, and risk are substantially modified or absent when the microcopying technique is used.

The use of the techniques that are operative in the range below a hundred copies permits a similar change in the financial perspective. Here also the high promotion charge can be avoided, because the effective market is pretty well known in advance. Moreover, some of these techniques, notably the hectograph, operate at so low a

TABLE LV

UNIT COSTS FOR REPRODUCING 100,000 WORDS IN A VARIETY OF PROCESSES IN EDITIONS OF 1 TO 100

Process	Cost per Copy by Size of Edition					
	1	5	10	25	50	100
I. Processes in which the first stage is the making of a fresh typescript copy. (For these processes, the two original forms of the text are equivalent to each other)						
Typescript and carbons	$40.00	$12.16				
Hectograph, 300 words per page, with typing		15.56	$ 7.78	$ 3.65	$ 2.15	$ 1.47
Mimeograph, 300 words per page, with typing			13.24	5.58	2.99	1.67
Mimeograph, 600 words per page, with typing			10.77	4.42	2.36	1.28
Typescript-Photo-offset Model 700-D				12.56	6.28	3.14
II. Processes which begin with photography or blueprinting, from 334 pages of typescript						
B-W or Ozalid (black or dark red on white)	10.85	10.85	10.85	10.85	10.85	
Blueprint (white on blue)	6.51	6.51	6.51	6.51	6.51	
Blue line print (blue on white)		14.32	12.58	11.55	11.20	
Photo-offset, full size			66.80	26.72	13.36	6.68
Photo-offset, reduced to 70% in linear diameter			33.40	13.36	6.68	3.34
Photostat, full size, with negative as 1st copy	50.10 (neg.)	50.10	50.10	50.10	50.10	50.10
Microcopying, 16 diameters, part of long run, Recordak	.60	.45	.42	.40	.40	.40
Microcopying, 8 diameters, short run	1.72	1.72	1.72	1.72	1.72	1.72
III. Processes which begin with photography, from 250-page octavo book						
Photostat, full size	37.50 (neg.)	26.50 (all positives)	18.35	13.46	11.62	
Blue line print from paper negative		15.95	10.32	6.95	5.85	
Photo-offset, full size			34.37	13.72	6.86	3.43
Microcopy, 9 diameters, short run	1.30	1.30	1.30	1.30	1.30	1.30

cost level that the author himself can absorb the cost of production and the risk of loss. A substantial amount of scholarly publishing is carried on at present by means of subsidies from the author or from some institution representing an author interest. By shifting the technique of reproduction to one of the cheap, small-edition processes, the subsidy requirement can be diminished far below that which would be needed for publication in print.

Of course if an author expects to receive revenue from his research writing, he can not get it unless his writing is of the type that is appropriate for commercial publishing. The technical problem in the reproduction of his writing appears at another level, where the author is interested in the intangible rewards that are offered by the world of scholarship. In these cases the author sometimes makes a substantial investment in the reproduction of his work, either in the form of a subsidy to the press, or in the purchase of copies which he distributes to his colleagues. Author-financed reproduction of materials is far less burdensome with small-edition techniques than with commercial publishing techniques.

The possibility of choosing a technique to respond to the demand for a product encourages the development of another financing device, which would pro-rate the costs of production and distribution among purchasers. This device was examined in 1933 by the Joint Committee, and an experiment in its use is under way in 1936.

The essential element of the plan is the pro-rating of the cost of production among the purchasers, who are brought together before the production is launched and the sales price per copy fixed. This involves as a corollary the appraisal of the value of the work prior to its publication.

Publication Service of Microcopying

Another plan, utilizing the microcopying technique, is being launched in 1936 under the auspices of Science Service, with the collaboration of the Bibliofilm Service. The announcement of this plan, which is essentially one of deposit for microcopying in lieu of publication, is given out by Dr. Watson Davis in the following circular to the editors of scientific publications.

The development of photographic techniques makes it possible for Science Service to extend to you an invitation to participate in an auxiliary plan of publication which, we believe, will be of aid to you in editing your journal, proceedings, or other media of publication, and to scientific publication in general.

You, in common with other scientific editors, are probably under pressure from authors to publish papers of too great length or of too specialized content. Or there are papers that you would like to print in extenso if finances permitted. To a small specialized audience, these papers in complete detail should be made available.

The following suggested procedure will secure effective publication and conserve your finances. It is hoped that you will join with us in putting it into effect:

Publish as much or as little of a paper as you wish in your journal. In the case of a very technical paper, this may be merely an abstract or summary. State at the end of the published item: "For detailed paper order Document ________ from Science Service, 2101 Constitution Ave., Washington, D.C., remitting ________ cents for microfilm form and ________ cents for photocopies readable without optical aid." The author will have his paper typed in an acceptable standard form (black fresh ribbon on 8 1/2" x 11" bond paper, single spaced, preferably pica type) and he will have photographs mounted separately on same sized sheets. This material will be deposited by you with Science Service as a document. Science Service will assign a serial document number and set a price per copy of the document in microfilm or photocopy form. Those who wish to have the document will be able to obtain it by ordering it directly from Science Service in response to the notice published in your journal.

The operation of this plan of auxiliary publication will be simple and uncomplicated. Science Service desires that you and other editors use it when, how, and if it is helpful. We

> ask no financial participation or guarantees on your part or the part of the author. We only ask that you signify your intention of using this publication method if and when it fits into your editorial plans, and that you give the paper to be deposited such editorial supervision as you deem necessary.

The agreement to be entered into by the editors of scientific publications using the service is drafted as follows:

COÖPERATIVE AGREEMENT FOR UTILIZATION OF THE PUBLICATION SERVICE OF THE DOCUMENTATION DIVISION OF SCIENCE SERVICE

THIS AGREEMENT made and entered into this ____________________day of ____________, one thousand nine hundred and thirty-six by and between the ______________ ________hereinafter called the Cooperator, and Science Service, a non-profit Delaware corporation with offices at Washington, D.C., hereinafter called Science Service.

WHEREAS, the Cooperator is desirous of obtaining the publication of scientific papers and monographs that can not now secure prompt and complete issuance, and

WHEREAS, Science Service has developed and operates means of publication of scientific papers and monographs by photographic processes, and

WHEREAS, it is the intention of the parties hereto that such cooperative work shall be for their mutual benefit and for the benefit of the scientific world in general.

NOW, THEREFORE, for and in consideration of the promises hereinafter set forth, the parties hereto, do hereby mutually agree with each other as follows:

The Cooperator shall:

1. Obtain from authors acceptably prepared typescripts and illustrations of such material to which it is desired to give publication by means of the Publication Service of Science Service, performing such editorial services as in the Cooperator's opinion should be performed.

2. Deposit with Science Service such material as documents, with the understanding that all rights of the author and the Cooperator are thereby transferred to Science Service.

3. Publish a summary, abstract or short paper of each document so deposited, stating that the complete document may be obtained upon order from Science Service, and specifying the document number, the price of the document in microfilm form, and the price of the document in photoprint form, the size of the document, the name and address of Science Service, in form prescribed by Science Service.

4. Publish in each issue of journal or other publication containing such document notice as specified in paragraph three above, a statement of approximately one hundred words descriptive of the documentation activities of Science Service, such statement to be supplied the Cooperator by Science Service.

5. Allow the photocopying by Science Service's Bibliofilm Service of journals or other material published by the Cooperator, whether material is copyrighted or not, provided a period of one year has elapsed between date of publication and date of photocopying.

Science Service shall:

1. Receive documents approved by the Cooperator.

2. Assign to such documents serial document numbers and set prices for which copies of such documents will be furnished on order in form of microfilms (photographic images approximately 6" x 8" on paper).

3. Make photographic negatives of documents received and file them so that microfilms and photoprints can be reproduced from them when orders are received.

4. Arrange for the keeping of the originals of the documents in a permanent depository.

5. Furnish photographic copies of documents when and as ordered by individuals or institutions, at the price agreed to as provided in paragraph two above.

It is mutually understood and agreed:

That this cooperative agreement shall not limit in any manner the cooperation of either party with any other agency or person in any way.

That the provisions of this agreement relating to the furnishing by Science Service of documents in form of photoprints shall not be effective until approximately March 1, 1936, or later, when the judgment of Science Service deems that this service can be furnished expeditiously and at reasonable cost.

That this cooperative agreement shall take effect upon the day, month and year first above written and extend to and including March 31, 1937, subject to renewal thereafter by mutual agreement of the parties.

IN WITNESS THEREOF, the parties hereto have executed this agreement on the day, month and year first above written.

SCIENCE SERVICE, INC.

By ____________ By ____________
Director
Title ____________

Publication Service by a Deferred Payment Plan

Edwards Brothers of Ann Arbor have a standing offer intended to facilitate small-edition publishing by a simplifying of the distribution of risk between publisher and author or subsidizer. The terms of this proposal are the following:

1. They assume 50% of the initial cost.
2. The author, institution, or foundation assumes the other half, either in cash or in the form of advance orders on the book.
3. The advance is made for six months from date of publication, with a carrying charge of 10% based on the cost of the edition.
4. Repayment of the advance is made through first sales. Their experience has been that the author is seldom called upon to repay in cash--sales usually taking care of his indebtedness to them.
5. At the end of six months, any unpaid balance is to be paid; if this is not feasible, arrangements can be made for an extension.
6. If the book sells better than estimated, the author within three months can assume the entire cost, in which case their 10% carrying charge is eliminated.
7. All net sales, after the advance is repaid, are credited to the author towards royalty, payable April and September 15 each year.
8. They store, ship, and bill all books published under this arrangement, thus sparing the author or institution all mechanical sales routine.

In addition to these services, Edwards Brothers offers a publishing service described as follows:

1. They prepare and mail to a list of logical readers a circular describing the book and reproducing specimen pages from it so that the prospective purchaser may see the format.
2. This list may be furnished by the author or made up from the proper directories, membership lists, faculties, etc.
3. They list all books, according to title, author, format, date of publication, price, and publisher, in the appropriate indexes and in Publishers' Weekly, the book-trade journal.
4. They send out review copies of books to the important periodicals in the field concerned. Their list of 1400 periodicals classified by subject enables them to select for publicity purposes those magazines and journals which concern themselves particularly with the material treated.
5. For this service their charge is $25 for 250 names circularized, and $20 for each additional 250. There is no charge for publicity beyond this.

The production technique used in this case is photo-offset from typescript. The offer is really a breakdown of publishing service into separate elements of which the author can purchase as many or as few as he chooses, and a credit scheme that will give the author a chance to get 50% of the production price from book purchasers.

According to a letter just recently received, Edwards Brothers report that their plan is working quite successfully. They have had a number of books, ranging in an edition of from 300 to 900, which are selling and which are paying their own way. Their experience has been that they can, with an edition of 300 or 400 copies, produce a book which will sell at approximately current book prices of comparable material. In addition, they are finding that there is little if any objection to the format in which these books are prepared. Reviewers no longer comment on the format, and if they do, their comments are almost always favorable. An indication that there is no objection is the fact that the number of orders which they receive each day is constantly increasing. At the present time it averages from thirty to fifty orders per day.

This up-to-date information coming directly from the publishers using the plan is very encouraging, in that it indicates the favorable reception accorded the plan, and also the fact that these smaller editions will sell and pay for themselves.

The Services of the H. W. Wilson Company

The H. W. Wilson Company has had extensive experience in a special method of pro-rating costs of production among purchasers. The series of guides to periodical literature published by this company are priced on the basis of the number of analyzed periodicals to which the purchaser subscribes.

Another service of the Wilson Company is its vertical file service, which circulates among libraries a classified subject list of pamphlets and similar material that may be available either gratis or at cost of supply. It will be easy to arrange with the Wilson Company to receive titles of near-print memoranda issued by scholars on scholarly subjects, to circulate the notices of the material in the classified list, and to arrange for distribution to the libraries upon demand.

Plans for the Photo-Offset Reproduction of Rare Items

The proficiency with which the photo-offset technique will bring rare books into print has led to a number of systematic experiments in organizing reproduction of them.

The Facsimile Text Society was organized with a list of subscribing members and an editorial board to choose titles for reproduction. It could not escape the need for a large-edition sale, nor could it prorate actual costs among actual subscribers to a given title. In short, while it did not use printing techniques, and tried in its promotion to find a plan halfway between that of a journal with a subscriber list and that of a book publisher, it did not escape the accountancy and risks of book publishing.

Mr. John A. Neu of the Library of Congress has been a promotor of a large-scale plan for rearranging and rationalizing book holdings of American libraries. One part of his plan called for the multiplying of rare books. The idea that the production of the reprints should be planned to fit into a comprehensive arrangement of book resources in the country was new. The scheme did not get beyond the memorandum stage.

The H. W. Wilson Company has developed an effective book exchange service that should prove very sensitive in registering reprint demand. The company published a catalogue of essays and general literature as a kind of checklist for libraries. Since many of the items on this list were out of print, it issued a special list of the out-of-print books, and invited libraries and secondhand dealers to report copies for sale. Six titles were so much in demand, and so little in supply, that the Wilson Company made reprint editions--in this case from plates rather than by photo-offset--but the results were not a striking success. It may be that the immediately effective demand for the reprint of a particular rare and out-of-print book does not often pass the efficiency point of the reprint process, whether by photo-offset or from the plates. The problem, again, is one of financing the smallest possible edition.

Concentration of Scholarly Book Production

In the past few years there have been a number of proposals that look to the achievement of economies of consolidation in scholarly book publishing. It will be proposed, for instance, that university presses should merge to avoid wasteful duplication, or that a gigantic union publishing institution should be set up to compete with existing prices for profitable manuscripts, and expend its profits in the production of small-edition, loss-sustaining research books. The evidence accumulated in the preceding pages amply warrants the conclusion that the mere increasing of the size of present publishing operations will not meet present needs. What is necessary is a new design, and the use of new techniques, to the end that editions will finance themselves regardless of the number of buyers--whether it be ten or ten thousand.

Concentration of Processing Services for Microcopying

The development of microcopying on paper and film promises to yield low prices that will result in widespread use, and the widespread use will then reflect back in low prices. The critical problem of the moment is the maintenance of a low price level during the period of development that is bringing about the widespread use.

The institution which is probably most necessary for the achievement of this objective is a photographic processing center which can offer the following services:

1. Accept microcopy negatives, either 16 mm. or 35 mm., both in short and long runs, and service them to buyers by making on order positive prints in the same size, or in enlargement or reduction, and possibly on paper.
2. Pro-rate the costs of making a negative among purchasers of the positive on a non-profit basis.
3. Guarantee the highest technical standards in the care of the negative and the processing of the positive.

While it is highly desirable to encourage the development of a number of alternative photographing and reading machines, there is no advantage in splitting up the work of processing among a number of agencies. Efficient machinery is very expensive and calls for large footages. The scholar who returns from Europe with a few thousand feet of microcopies of unpublished material, the library that has made a negative of its newspaper file, the group of libraries which may be organizing an undertaking such as the copying of English books published before 1640, could all make use of a processing center. The accountancy standards remain to be worked out; they will show marked differences from the accountancy of publishing. They should be established on the assumption of large footages.

Five years ago, when the first edition of this report was issued, it seemed that the most important need in the field of microcopying was mechanical--the efficient camera and reading machine. At this date of writing, the mechanical problems are so well on the road to solution that they need not cause concern. The next problem is one of institutional development and of the standardizing of a low price level.

Allocation of Costs, and the Problem of Appraisal and Listing

The problem of allocation of cost is intimately related to the problem of appraising the research value of material that is to be multiplied by any technique for any number of users.

The cost may be assessed against the author (or some institution interested, like the author, in promoting distribution), or against the library and the individual consumer, or it may be distributed among them. It may be met by any one of the three interests identified in the first chapter of this book as the producer, consumer, and custodian interest, or by all of them in different proportions. But the allocation of cost cannot be made except in the presence of some kind of appraisal.

If the author bears the whole cost of multiplying the book and distributes it free of charge to libraries, no act of appraisal of the book is necessary except that which the receivers of the book will perform in deciding whether to shelve the gift or put it in the wastebasket.

If the people who are to acquire the book are to be asked to contribute toward the cost of multiplying it, the work of appraising must precede their decision to assume part of the cost of multiplying.

At present this appraising is done in two ways. The most common is that used in the publishing trade. An editor appraises a manuscript and makes a decision to publish; then reviewers step in, and on the basis of their reviews purchasers make their decisions.

Sometimes the editors assume so much responsibility, as in bringing out a series, that the purchasers do not await the second appraisal made by reviewers. This is the second of the two systems now in use.

These methods do not place a large proportion of the cost on the purchasers of books; the author of a Ph.D. dissertation bears most of the cost.

Both of these methods of appraising books and distributing their cost between authors and buyers leave a large margin of risk. While they have been developed in connection with the technique of printing, they are not necessarily tied to that technique.

A third arrangement would be possible. The appraising of the book could be made, not only prior to the multiplying of it, but prior even to the distribution of its cost between author and purchasers. This is the system proposed in a memorandum of the Joint Committee on a publishing service.

There are two functions in connection with the distribution of the results of research which are more intellectual than mechanical. The first is the entering of information regarding the research product in bibliographical guides; the second is the appraising of the merit of the research product. This work is done by professional scholars, who may or may not be remunerated for it.

The two functions are related. A bibliographical entry implies a degree of appraisal; at least the research product must be assumed to relate to the topic under which it is entered. This amount of appraising can be left to the author or, in the case of Ph.D. theses, to those under whom the work was done.

The more complete appraising that is necessary before asking purchasers to contribute toward the cost of multiplying a book is not so properly left to the author or his advisor.

No matter what techniques of reproduction are used in multiplying a text, these problems of appraisal and assessment of cost arise.

The rational use of these available techniques requires, however, that the intellectual elements of the distributing process, namely, bibliographical entry and appraisal, should be made available regardless of the technique of multiplying.

Intellectual Implications of Technological Change

A change in the procedure of appraisal of material and a development of bibliographical services to include material not commercially published open the way to far-reaching changes in the intellectual standards of scholarship. At the same time the prospect that a scholar may be able to have material that was otherwise inaccessible brought to him, and that he may be able to communicate to his colleagues writings that he has hitherto been unable to communicate to them, open the way to new intellectual opportunities. An analysis of these new standards and opportunities points toward a large-scale redivision of scholarly labor, which may take a course parallel to that which industrial technology introduced when it opened to the semi-skilled a great field previously occupied by the highly skilled.

The semi-skilled in scholarship have played a very small role in intellectual life for the past few generations; the amateur has given way to the professional in research, and the vast corps of teachers in the secondary schools have not been mustered into the army of productive scholarship. The concentration of scholarly work has taken place not only in respect of personnel, but also in respect of location. Large library resources have become so necessary that most of the work has been drawn to great cities and university centers. We look out now upon a prospect of change, which can be examined in several aspects. First among these aspects is the prospective disintegration of the distinction between collecting and publishing.

Microcopying and the reproduction techniques that are operative in the zone of ten copies tend to obliterate this distinction, because they mean that any collection of material--whether in manuscript, typescript, or book or pamphlet form--can be duplicated or multiplied in whole or in part upon demand. If a library has collected the theatre programs, political broadsides, or other documents originating in its community, this material has not only been preserved from destruction, but also prepared for distribution. Moreover, a collection of material can be made logically complete, regardless of the accident of the market, and become in that way an organized unit, as if it were a vast and well-designed book. Collections of documents in the hands of any librarians or individuals who are willing to permit their copying become part of a great reservoir of documentation, open to all comers, irrespective of whether or not any item is a "book in print."

This conception--that collecting and publishing are functionally merged--should operate to expand and dignify the role of the collector, and at the same time to clarify the position of the research worker. It should become increasingly difficult for scholars to publish undigested material in the expectation that their work will be credited as if it were a true product of research, provided only that the texts as published had not previously appeared in print. Already the effect of the new techniques can be felt. A number of scholars have gone into European archives and brought home collections of documents numbering into the thousands in microcopy form. If they had gone with pen and ink or with typewriter, and laboriously copied out a few hundred documents they might have been tempted to confuse the result of their physical labor with an intellectual product. Since it is now evident that the camera can not only copy documents by the thousands, but also permit their duplication to order and upon demand, the difference between the mere collection of documents and their research use stands out with a clarity it could not previously have possessed.

This observation does not decry the value to culture of that work which tends to improve and expand records, to make them more accessible, and to notify those who should be interested in them of their existence. This is an essential service which must be rendered. But there should arise a new conception of division of labor in scholarship, combined with a willingness to apportion tasks to the abilities and opportunities of those who are available to do the work.

The labor of research is doubly divisible. It can be divided vertically into ever narrower fields, and it can be divided horizontally into different stages in the preparation of material. At the first level stands the collection of records--the function generally left with librarians and archivists. Between the collection of texts and the distribution of conclusions drawn from their study, there stands a long intermediate series of operations, to each of which there corresponds some appropriate intellectual technique in the treatment of the material, and some appropriate mechanical technique for its reproduction.

Many of the obstacles to be overcome in the development of the full material resources of intellectual life are found in the attitudes of the scholars themselves. Too often there is a veneration of book print at the expense of typescript, and too frequently a disposition to take for granted the finality of the existing distribution of labor. But an examination of the whole problem of materials for research discloses the fact that the problem can not be solved in terms of book publishing on the one hand, and the labor of professional scholars alone on the other.

The nature of the whole problem of materials for research will be clarified if it is examined as a series of operations that begins with the collecting of original material and ends with the dissemination of the results of research.

The First Stage: Collecting and Preserving Material

We are called upon to manipulate a civilization based primarily upon the use of two substances--metal and paper. Just as our economic life has come to be based upon the use of metals, so our intellectual life has its material foundations in the use of paper.

The world of paper is a world of vast dimensions. Primarily, it is not a world of books. A single copy of the New York *Times* contains more words than a full-length novel. Books constitute only a small part of the printed reading matter that is laid before our eyes. Most of the printed material that is distributed is distributed in newspaper form. But the newspapers absorb only a fraction of the actual writing that is done. In every business office there are typewriters that clatter all day putting words and numbers on paper. That which is printed is only a fraction of that which is written and communicated. For every ton of paper that is converted into records, there are, perhaps, only a few pounds that will ever be added to the permanent heritage of records to be utilized in the study of our civilization, and preserved for the future.

How is the selection to be made of records that are to be preserved? How are they to be segregated from the records destined for destruction? And how is the scholar to be guided among those that are preserved, to the end that their preservation will prove to be worth while? Our libraries operate efficiently in respect of certain classes of books and periodicals, and even of newspapers and some kinds of old manuscripts. But there are vast domains of records which our libraries cannot be expected to govern. The records of business and of government and the private papers of families must, in the long run, be cared for by business and government and the family. Only by inculcating in people who are not professional scholars a sense of the value of records, and by teaching a technique applicable to their selective destruction and preservation, can this great bulk of record material be given a rational treatment. A program that would attempt to solve the problems of preserving and improving materials for research, without any resources but those of professional scholars and research libraries, will leave the great decisions to the play of accident.

Even the ample and intelligent selection and preservation of records that are made in the course of practical life would still leave a great gap in the documentation. Are there not many kinds of information that are of intrinsic interest and value to research scholarship, even though they do not take the form of records unless a deliberate effort is made to record them? This is true not only in the field of linguistics, but also in political and business history, and in family history as well. The development of radio, which does not automatically make a paper record, imposes a special duty of recording for permanence, if the archive of culture is to be complete.

The field of original record is so vast that the conclusion must be self-evident; only the recruiting of forces supplementary to those of professional scholars and research libraries will bring ample and intelligent action in the preserving of old records, in the selection of contemporary records for preservation, and in the making of new records.

The human interests that may be turned to account to improve our resources of record are many. Chief among them are the genealogical interest, the interest of people engaged in business in the background and prospects of their business, the collector's interest in a good collection of anything from postage stamps to incunabula, and perhaps a feeling for the prestige-value of contributions made to the intellectual world.

We are not yet intellectually prepared to develop these human resources. We do not yet know exactly how to instruct the college student of today, the business man of tomorrow, in the techniques and values that he ought to know if he is to participate in a great common enterprise in the development of record resources. We have not yet worked out fully the institutional arrangements by which collections of records, preserved from the past or made in the present, can be appraised, reported, and brought to the attention of those who can use them. We have not yet analyzed thoroughly the categories into which research materials fall, nor devised for each category appropriate principles to govern their preservation, selection, creation, or listing for use. This intellectual problem would exist for us, even if we were still dependent upon book publishing for all multiplying of research materials. But the new techniques, since they render collecting almost equivalent to publishing, make the problem far more pressing, and the opportunity far greater, than it has been in the past.

The Second Stage: the Improvement of Different Types of Material

The creation, preservation, and collection of research material in vast quantities will embarrass rather than aid scholarship, unless appropriate measures are taken to improve it by arranging it properly, and controlling it by means of lists, inventories, calendars, and other ways.

The classes of record that account for the greatest bulk of paper tonnage are the following:

(a) Books, Periodicals, and Printed Public Documents

Present library techniques are adequate to care for this material, although library resources are in some cases insufficient. The public documents of the American states and of foreign governments are very inadequately represented in American libraries. But the method of meeting this deficiency will probably be found to involve no other changes than an increase in library resources or a distribution of library responsibilities, to the end that the holdings and acquisitions of one library may dovetail with those of another, and the technique of microcopying provides inter-library service. The union catalogue of libraries and the union lists of newspapers and public documents are the tools required for the improvement of this situation. The Wilson Company has made a union list of periodicals and of public documents, and a number of union catalogue projects are under way, notably the great Project B of the Library of Congress, and the union list of the holdings of libraries in Philadelphia.

(b) Newspapers

The newspaper resources of the country, taken as a whole, reveal just such gaps as are shown in periodical and foreign public document holdings. A newspaper union list is in the making, but newspapers present two additional tasks. The paper upon which newspapers have been printed since the last quarter of the nineteenth century is so highly perishable that the whole newspaper record will be lost unless large-scale copying or preserving is done. Probably the best plan will be to microcopy the files, but, despite the low costs of the process, this will be a long and expensive process.

The bulk of newspaper files is so great and the miscellaneous character of their contents so general, that a distinct step forward in the improvement of this type of record can be made by indexing, calendaring, or digesting the files. The Joint Committee has experimented with the technique of making a newspaper digest in Cleveland, adapting the procedure to the training and abilities of a high-school graduate relief worker, and planning to multiply the resulting digest by means of the multigraph process. Though the hectographed digest will not be permanent, it will last long enough to provide many years of study, and a microcopy of the digest will be made to give absolute permanence to the work.

The labor cost of indexing or digesting newspaper materials is so great that the work can hardly be accomplished except under one of two conditions--either it can be developed by paid labor as a part of a relief program, or it can be done in small increments by people interested in the variety of information that the old newspapers reveal, and willing to work to put the material into near-print form for the sake of the intangible reward of scholarly recognition. The newspaper digest is a halfway product, intermediate between the raw newspaper material and the finished result of research.

There is one great news source that is not at present preserved in any form. This is the typescript material that passes over the wires of the great news services. It is the raw material of news, nearer to source than the newspaper itself, and more independent of the whim of the city editor. Dr. T. R. Schellenberg has taken the lead in promoting the preservation of this type of material by the microcopy technique.

(c) Public Archives

The erection of a National Archives building and the creation of a National Archives administration mark a new day in the treatment of public records in the United States. This country has hitherto been backward--almost barbarous--in the care of its public records. The conjunction of the establishment of the National Archives and the promotion of white-collar relief projects under the Works Progress Administration is changing this picture. Two large-scale and systematic inventories have been organized throughout the country under the Works Progress Administration, the one to make an identification inventory of the records of local public bodies, the other to make an inventory of federal records outside of Washington. The Historical Records Survey, under the direction of Dr. Luther Evans, is also covering some of the manuscript records, especially those in historical societies, and consolidating information regarding them.

There are three questions relating to public archives which deeply concern research scholars. First is the question of record destruction. No archive administration can or should preserve everything, and yet the selection of material for preservation, and the decision on what to destroy, are not easily made. Second is the question of inventory. Even if records are preserved, they are of little use to scholars until they have been inventoried and arranged. And third is the question of access and administration. As local archives come to be better known and their research uses better understood, it will follow that people who are not close to large libraries will have an increasing array of opportunities for research. It may be that techniques comparable to that which is being developed in the making of a newspaper digest can be worked out, to result in an equivalent increase in the accessibility and utility of local archival material.

Though sociologists have utilized local data very effectively, the historians, economists, and political scientists have devoted far more attention to the national scene. A leading political scientist, who is undertaking a study of the rise of machine politics in American cities, found that the basic preparatory work has not been done. The practical need for the study of regional economic opportunities finds economics far better equipped with statistics on national trends than with scientific analyses of local situations. Newspapers and the local archives are a vein of raw ore inviting the labor of a host of workers to dig out material and refine the product.

(d) Business Records

The archives of business are no less important than the archives of government, but they are not ordinarily administered with a view to their research value in the future. When an office manager is employed to increase the working efficiency of a business office, one of his first points of attack is the storage of old records. He tries to get them destroyed to save storage space. No business can afford to retain all records in their original and bulky form. The Recordak Corporation offers to business firms an opportunity to reduce greatly the space required for the preservation of old files. Nevertheless, the introduction of sound scholarly archival principles into the care of business records is a program for the future, rather than a fact of the present.

The Joint Committee made an experiment in inducing a firm to apply the principle of sampling to the preservation of records. Halle Brothers, a Cleveland department store, withdrew from the normal course of destruction sample runs of all its types of records to cover a period prior to the introduction of NRA and a period subsequent thereto. Most American business firms have already destroyed the original pay rolls, materials cards, work cards, etc., that would document the story of this experiment in large-scale change of working standards. At the suggestion of Professor N. S. B. Gras, of Harvard University Graduate School of Business Administration, Mr. Ralph M. Hower was employed to draw up a report on the records and methods of record preservation used by ten different companies of considerable age and importance. The Business Historical Society is interested in developing a technique for the preservation of the important segments of business records. But the road forward is not so clear in the case of business records as it is with public archives, newspapers, and the books and periodicals handled by libraries through the book trade.

(e) Ephemeral Materials and Non-Trade Documentation

Though the library technique for dealing with books, periodicals, and newspapers is well established, the same can hardly be said of ephemeral items such as political posters and broadsides, pamphlets, advertising matter, theatre programs, and a great variety of near-print matter. Dr. Kuhlman of the University of Chicago Library is preparing a manual for librarians on the collection and arrangement of this type of material. But here also there is a great field for the individual collector. During the World War a large number of individuals in Germany and many in France began their "war collections." There were several journals published to serve the collectors. With the close of the war this interest diminished. But there are an almost infinite number of subjects upon which the serious and comprehensive activity of an individual collector can bring valuable results. Every labor dispute in a modern city gives rise to its little budget of leaflets and announcements from the different labor groups and the management. Every demonstration of relief clients is accompanied by its paper shower. These documents are a part of the record of civilization that will not come to be preserved and organized, except as individuals or local libraries take a special interest and apply a sound technique.

(f) Family Papers

The restricted space in which the

modern family lives, and the frequent moving from apartment to apartment that becomes normal in urban civilization, make the hoarding of family papers, whether ancient or current, a burdensome load. Surveys of historical documentation in New York, Pennsylvania, Virginia, and other places have disclosed a wealth of valuable records in the form of old letters. The complete rationalization of the care of family papers would call for at least three things: first, the reporting of holdings of old papers; second, the proper selection, preservation, and care of current papers; and third, a responsibility in each family to record the history of itself, or the biography of its members.

The interest that many individuals develop in genealogy can perhaps be channeled in such a way that it will yield results valuable to the world of scholarship. Dr. Jean Stephenson, Chairman of the Genealogical Records Committee of the Daughters of the American Revolution, is sounding out this possibility and is prepared to develop it in a forthcoming manual on genealogical research.

Thus the collection, selection, listing and care of records, whether public archives, business documents, or family papers, is a vast task in which a large element of the population can be trained to share. The value of everything they do will be increased by the greater mobility that all records possess by virtue of the new techniques of reproduction.

Simplified Research Techniques

Above the level of the simple collecting and organizing of material, there lies a zone of possible activity intermediate between the higher research, to which the highly trained professional scholars may be expected to devote their time, and the more humble task of accumulating and arranging. The proposal has been presented to the American Council of Learned Societies and the Social Science Research Council that steps should be taken to devise simplified research techniques, by which the semi-skilled in scholarship could make their contributions, and those who have only a limited amount of time or limited documentary equipment for research, may be brought to contribute their share.

The development of simplified research techniques in the social studies and some of the humanities would result in an increase in the actual working personnel of American scholarship, especially by drawing in the following types of workers:

a) University, college, and high-school teachers who, because of limitations of time, materials or training, are not able to keep the pace set by the most advanced research workers.
b) College graduates, not engaged in academic work, but having at their disposal time and interests--in some cases money --that can be devoted to scholarly purposes.
c) Business men whose interest in their own business or the economic setting of their own community is guided toward accurate and sound methods of investigation.

The broadening of the base of the pyramid of scholarly activity would contribute to the whole field of education. The schism in the intellectual world that resulted from the preoccupation of those interested in pedagogy with methods of instruction, at the expense of content of learning, and of research workers in content, at the expense of methods of instruction, has not strengthened, but rather has weakened intellectual life. It has resulted in a situation in which the teaching career, especially in the secondary school, is made less attractive in terms of intellectual dignity than it would need to be. A good teacher can always teach more effectively if she is able to illustrate generalizations in history, social studies, or other fields from local and familiar instances. But such illustrations presuppose a sound investigation of the local data in relation to the general findings of a discipline; and if such an investigation is made, its result is more than an item of teaching material; it is, in fact, an additional datum in the inductive structure of the discipline itself.

The present generation should not be surprised at the conclusion that a technological revolution has in it the seeds of a cultural revolution. Such may indeed be true in this instance. The cultural revival of the small town as against the monopoly of the metropolis, and the democratization and "deprofessionalization" of scholarship are on the horizon which seems to lie ahead. And these things, themselves, accord with other elements of our social and economic prospects--notably the possible decline in the centralization of population in cities and the development of a new leisure in the hands of a well-educated people. The same technical innovations that promise to give aid to the research worker in his cubicle may also lead the whole population toward participation in a new cultural design.

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INDEX

A.A.A. Hearings, 131, 132, 150, 151, 152, 172
Ansco camera, 123, 161, 168-9
Aperture, 146-7, 148, 150
Aquatone, 89
Archives, 199
Argus camera, 161, 164, 168

Bausch and Lomb, 116, 150, 173
Beane, Donald P., 3, 4, 5, 6, 7, 9, 20
Bendikson, Dr. L., 117, 118-9, 123, 124, 125, 151, 164
Bibliofilm Service, 134, 140, 144, 151, 184, 192
Binding, 111-113
  spiral, 111-2
  stapling, 111
  stitching, 112-3
Binding costs, 113
Blueprint paper costs, 70
Blueprinting (see also Van Dyke, Lithoprint, B-W), 65, 66, 77
Business records, 200
B-W Process, 66, 67, 68, 77

Carbon copying, 41, 42
Cheney, O. H., 3, 4, 6
Cinescopie camera, 123, 162, 164
Collotype (see Photogelatin)
Contact copying, 68, 71
Contax camera, 131, 159, 161, 164-8
Copyright, 135-9

Dagron film, 123, 125, 157
Davis, Dr. Watson (see also Science Service), 141, 150, 191
Dermaprint, 14, 27-9, 90
Dexigraph, 76, 158
Direct-Typing offset, 46, 47
Ditto (see Hectographing)
Draeger camera, 123, 135, 151, 161, 170

Edwards Brothers Publishing Plan, 193, 194
E.K.A. camera, 123, 161, 164
Electromatic typewriter (see Typewriters)
Electrotype, 17, 19, 25, 30
Elite type (see Type)
Emulsion, 121, 122
Enlargement ratio, 147

Fair copy, 34ff.
Film costs, 125, 126
Film durability, 152, 153
Film storage, 113-4, 152-5
Filmograph camera, 161, 162, 174
Filmstats, 117, 121, 134
Fiske, Bradley A., 117
Fiskoscope, 117
Folmer Graflex Corporation, 124, 125
Folmer Graflex Recording Camera, 119, 150, 151, 152, 161, 170-1
Formats, 35, 38, 49, 54ff., 59
Format copy, 34, 37, 38

Greene, E. B., 53

Half-Tones, 85-6
Hanley, Dr. Miles L., 177ff.
Harris Press, 22, 86
Hectograph
  area costs, 44
  composition costs, 44
  legibility, 44, 45
  permanence, 44, 46
Hectographing, 41-6
Hoch, Fred, 3, 18, 23, 52, 60, 62

Interlinear spacing, 38
International Filmbook Company, 144, 150, 151, 152, 155, 174
Intertype, 14, 16

Kennedy camera, 123, 131, 169-70, 174
Kletsch, Dr. Ernest (see also Mimeoform Process), 19, 158
Kuhlman, Dr. A. F., 153, 200

Legibility, 17, 24, 25, 32, 40, 41, 53, 54, 58, 115, 116, 123
Leica camera, 123, 131, 159, 161, 164-8
Leitz Company, 150, 154, 161, 173
Linotype, 14, 16
Lithoprint (see also Blueprinting), 65
Ludwig camera, 161, 169
Ludwig, Frederick, 169
Lydenberg, Dr. H. M. (see also Copyright), 135

Manuscript book, 62, 63
Margin, Justifying right-hand, 33, 55
Marshall, Dr. John, 3, 6
Matson camera, 161, 169
Meiner formula, 5

Metal plates
  costs, 48
  multilith, 28
  preparation of, 23
  preservation of, 25
  rotaprint, 24, 28
  utilization of, 23
Microcopying (see Chapter XI), 93
  first costs, 131
  reprint costs, 133-4
  running costs, 131
Mimeoform process, 19-20, 30
Mimeograph stencils, 47ff.
Mimeographing, 46, 48, 54
Monotype, 14, 16, 19
Multigraph, 14, 18, 19
Multilith, 21, 27, 46, 47, 48, 53, 86, 87

N.R.A. Hearings, 131, 132, 144, 150, 151, 152, 155, 172
Neu, Dr. John A., 194
Newspapers, Reduced size, 115, 116
New York Times, 24, 105, 113, 115, 117, 124, 130, 155, 157, 197

Ormig (see Hectographing)
Ozalid (see Blueprinting), 66

Pantone, 89-90
Paper (see also Chapter VIII)
  legibility, 109
  preservation (newsprint), 105, 155
  prices, 104
  Scribner-Burton specifications, 106
  specifications, 98ff.
Paterson, Dr. Donald G., 25
Peters, Dr. Charles C., 23, 116, 117
Pica type (see Type)
Photoengraving, 22, 85
Photogelatin, 84, 87-8, 92
Photographic negative, 22
Photogravure, 88-9
Photo-Offset, 13, 14, 19, 21, 25, 30, 53, 77, 85
  area costs, 22-5, 30, 53, 55
  composition costs, 22, 30, 37
  format formula, 56ff.
  reprinting, 21, 25-6, 30
  running costs, 30, 55
Photoscopie, 162
Photostat paper, 67, 72, 73, 74
Photostating, 13, 14, 66, 67, 71-5, 77
Pratt, Verneur, 121, 128, 140-1
Printing, 14-8, 20, 30, 182
  area costs, 13, 16-7, 30
  composition costs, 13, 15-6, 30, 37
  first costs, 13, 30
  reprint costs, 13, 30
  running costs, 13, 14, 17, 30
Processing costs, 129-31, 133
Projection equipment, 141ff., 151, 172-6

Randall, Dr. William M., 9, 10
Recordak copying camera, 123, 131, 161, 171-2
Recordak Corporation, 75, 114, 122, 130, 131, 134, 150, 151, 152, 154, 155, 200
Recordak projector, 143, 144, 146, 150, 151, 174
Rectigraph, 73, 75
Reduction ratio, 121, 122-5, 133, 141
Reflection copying, 71, 159
Reprinting (see Photo-Offset)
Resolving Power, 121, 123
Right-Hand margin (see Margin)
Rotaprint, 21, 27, 46, 47, 48, 86, 87

Schellenberg, Dr. T. R., 131, 132, 199
Science Service, 140, 191-3
Scribner, Dr. B. W., 98, 106, 125
Seidell, Dr. Atherton (see also Filmstats), 114, 117-8, 134
Short Title Catalogue, 132, 133
Simplified research techniques, 201-2
Spencer Lens Company, 118, 150, 151, 173
Spielvogel, Joseph (see Vogeltype Paper)
Spiral binding (see Binding)
Standard Duplicator (see Hectographing)
Standardization in microcopying, 141ff.
Stapling (see Binding)
Stephenson, Dr. Jean, 201
Stereotype, 17, 25, 30
Stineman developing reel, 130
Stitching (see Binding)

Tate, Dr. Vernon D., 175
Tinker, Dr. Miles A., 25
Tru-Vue, 119-20
Type
  elite, 16, 31
  micro-elite, 32
  pica, 16, 31
  sizes, 17
Typewriters
  Electromatic, 33, 34, 41, 62
  standard, 31, 38, 82
  Varityper, 33, 34, 38, 82, 83
Typing costs, 34ff.

Union catalogues, 158, 159

Van Dykes (see also Blueprinting), 65ff., 77
Varityper (see Typewriters)
Vernon, M. D., 17, 24, 38, 40, 54
Vertical filing, 111
Vogeltype paper, 33, 55

Wilson, H. W. Company Plan, 194
Wilson Union List, 135, 199

Proper Name and Address Index

A. A. B. Dick Company
720 West Jackson Boulevard
Chicago, Illinois

Agfa Ansco Corporation
Bingingham, New York

Argus Camera
International Research Corp.
Ann Arbor, Michigan

B. Bausch and Lomb Company
Rochester, New York

Donald P. Bean
U. of Chicago Press
Chicago, Illinois

Dr. L. Bendikson
Huntington Library
San Marino, California

Bibliofilm Service
Department of Agriculture Library
Washington, D. C.

Dr. Joseph Broadman
110 West 42nd Street
New York, New York

C. O. H. Cheney
National Association of Book Publishers
New York, New York

Chicago Planograph Corp.
517 South Jefferson Street
Chicago, Illinois

Cinescopie Company
29 Rue aux Laines
Bruxelles, Belgium

Contax Camera
Carl Zeiss, Inc.
485 Fifth Avenue
New York, New York

Continental Lithograph Corp.
Cleveland, Ohio

Copifyer Corp. of Ohio
1111 Power Avenue
Cleveland, Ohio

D. Stanton L. Davis
Case School of Applied Science
Cleveland, Ohio

Watson Davis, Director
Science Service
2101 Constitution Avenue
Washington, D. C.

Dexigraph Corporation
Remington Rand, Inc.
465 Washington Street
Buffalo, New York

Dill and Collins Paper Co.
Richmond and Tioga Streets
Philadelphia, Penna.

Ditto Duplicating Company
Harrison at Oakley Blvd.
Chicago, Illinois

R. R. Donnelley and Sons
350 East 22nd Street
Chicago, Illinois

Dr. R. H. Draeger
Care of Bibliofilm Service
Dept. of Agriculture Library
Washington, D. C.

E. Eastman Kodak Company
Rochester, New York

Edward Stern and Co., Inc.
140 North Sixth Street
Philadelphia, Penna.

Edwards Brothers, Inc.
Ann Arbor, Michigan

Electromatic Typewriters
International Business Machines
270 Broadway
New York, New York

F. Folmer Graflex Corporation
Rochester, New York

Bradley A. Fiske
Commodore Hotel
42nd Street and Lexington Avenue
New York, New York

G.

H.

I. International Filmbook Corporation
Rockefeller Center
New York, New York

J.

K. Lloyd B. Kennedy
1556 Mahoning Ave.
Warren, Ohio

L. E. Leitz, Inc.
60 East 10th Street
New York, New York

Lithoprint Company
41 Warren Street
New York, New York

H. M. Lydenberg, Director
New York Public Library
New York, New York

M. Thomas P. Martin
Manuscripts Division
Library of Congress
Washington, D. C.

Meriden Gravure Company
Meriden, Connecticut

Mimeoform Service
1320 F Street, N. W.
Washington, D. C.

Multigraph Corporation
1200 Babbitt Road
Cleveland, Ohio

N. National Process Company
75 Varick Street
New York, New York

O.

P. Dr. Charles C. Peters
Pennsylvania State College
State College, Penna.

Photoscopie, Inc.
121 Rue Berckmans
Bruxelles, Belgium

Photostat Corporation
303 State Street
Rochester, New York

R. Recordak Corporation
350 Madison Avenue
New York, New York

Rectigraph Corporation
Rochester, New York

Rotaprint Corporation
Prospect-Fourth Building
Cleveland, Ohio

S. Dr. T. R. Schellenberg
The National Archives
Washington, D. C.

B. W. Scribner
Bureau of Standards
Washington, D. C.

Dr. Atherton Seidell
U. S. Health Service
Washington, D. C.

Spencer Lens Company
Buffalo, New York

Spiral Binding Company
Chicago, Illinois

Standard New Process Duplicator
Standard Mailing Machines
Everett, Massachusetts

T. Tru-Vue Company
Rock Island, Illinois

Tudor Press, Inc.
251 Causeway Street
Boston, Massachusetts

Typary and Typon Company
1-4 Red Lion Passage
Fleet Street
London, England

U. Ullman Company
319-327 McKibben Street
Brooklyn, New York

V. Paul Vanderbilt, Superintendent
Union Catalog Project of Philadelphia
Commercial Museum
34th below Spruce Street
Philadelphia, Penna.

Varityper Corporation
2 Lafayette Street
New York, New York

Vogeltype Aligning Paper Corp.
24 Commerce Street
Newark, New Jersey

W. Miss Marion Wilson, Supervisor
Cleveland Union Catalog Project
Thwing Hall
Western Reserve University
Cleveland, Ohio

Worthy Paper Company
West Springfield, Massachusetts

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